FAA Aviation Education News

AVIATION LESSON PLAN

A new plan to start aviation studies at an early age is offered by the Federal Aviation Administration (FAA). The story of flight, from kites to space ships, is told in a series of lessons called **"Airlift for Young Minds."** The technical knowledge can help prepare young students to compete in the modern world.

Elementary schools can add the lessons to science classes without extra cost or teacher training. Students are led to learn by experiments and discussions to sharpen thinking power.

"Airlift for Young Minds," was written and developed by Kendall K. Hoyt, noted aviation journalist; and Susanne Paper, a teacher at the Lakewood Elementary School. This teaching guide has been tested in the Maryland School System.

The FAA has over 75 Aviation Education Resource Centers that provide teaching materials from federal, state and private resources.

Additional copies of the "Airlift for Young Minds," can be obtained from the FAA Aviation Education Resource Center nearest you. A list of Resource Centers is included in this package along with a list of FAA aviation education materials.

Also included in the package is the **Illinois Plan** for local action groups of parents, teachers and aviation people. These support groups can back school programs and boost flight training urgently needed at many home-town airports.

Attachments:

Airlift for Young Minds
Illinois Plan
FAA Aviation Education Resource Centers
List of FAA Aviation Education Materials

U.S. Department
of Transportation
**Federal Aviation
Administration**

AIRLIFT FOR YOUNG MINDS

TEACHING GUIDE

Elementary Aviation Lessons
for Science Classes

By KENDALL K. HOYT and SUSANNE B. PAPER

Reprinted by Federal Aviation Administration

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IMMEDIATE START

AVIATION EDUCATION is truly Airlift for Young Minds. It implants knowledge needed not only to fly but to succeed in modern life. Teaching aids, pre-school through high school, can be had from federal, state and private sources. Results are spotty for lack of a master plan to fit the pieces together.

For large numbers, the need is for a how-to guide that can be followed readily by any teacher, school or school system.

Pending more new lessons, it should not be hard to adapt existing ones. First review available texts. A great variety of teaching aids can be had free from some 75 Aviation Education Resource Centers maintained by FAA and the States.

See page 5 for a list of best teaching aids. Ask also for a copy of the Illinois Plan for organized local action. It includes education action groups of aviation people, teachers and parents. Form one. It can sell the Airlift idea to school authorities. Local pilots can advise, teach and arrange support events. Copies of this teaching guide are also available.

THE CO-AUTHORS

Colonel Kendall K. Hoyt is a writer with varied aviation background. As manager of the National Aeronautic Association, he helped organize the Civil Air Patrol. An Air Force officer in World War II, he started and directed the CAP cadet program which recruited and pre-trained thousands of aviation cadets. In recent years, he wrote the Illinois Plan which won the 1991 award as the most innovative state program and is distributed by FAA.

Susanne Paper is a science teacher in elementary schools, Montgomery County Maryland and a member of the Curriculum Committee, National Science Teachers Association. She was cited by the General Aviation Manufacturers Association as outstanding in aviation education. She developed the Airlift lessons by teaching them.

Acknowledgements Adm. Donald D. Engen, who headed the Federal Aviation Administration, approved Hoyt's plan for airport action groups. Aviation education groups were added under the direction of Richard M. Ware, Illinois Division of Aeronautics. Phillip S. Woodruff, FAA Education Director, has the plan printed for distribution. William F. Shea, former chairman of FAA's Education Committee encouraged the plan. Frances Leighton Hoyt helped edit this guide.

The lessons have been reviewed by the Curriculum Committee, National Association of Science Teachers. These educators agree that they can be taught in any school grade.

U R G E N C Y

AMERICAN SCHOOLS are among the worlds best but students' scores are among the worst, weak in science and math, needed for modern industry. Millions leave school each year unprepared for college. U.S. workers, despite vast sums spent for retraining, are outdone by skilled foreigners, a factor in trade deficits, national debt, unemployment and recession. The situation is not improving.

Learning goals are set for Year 2000 without progress in attaining them. Meanwhile the trade war intensifies. Europe is uniting. Communist nations are freed to compete. Pacific-run nations exploit the technology we gave them. The time to act is now.

The schools could not check the decline of learning. Now their job is to find remedies. Conditions will be slow to improve. Change -- political, economic and social --- have left young people without discipline as in other countries.

The only thing schools can do is try to make classes so interesting that students will want to study. Featuring sports or the performing arts will do this but does not push math and science. Aerospace studies do, but offer limited career opportunities and few experts to help in most areas.

Aviation education is the tested way. In all areas, well paid and entering jobs can be found. At airports, students can see airplanes and learn to fly when old enough. Aviation people--men and women, including veterans, can form action groups, and advise, teach and be role models.

With their help, an Airlift program, local or national requires no added funds, either federal, state or local; no legislation, no change in school systems; and no special training for teachers.

The glamor of flight excites youngsters from an early age. As make believe pilots, they go for studies that otherwise would seem dull and unrelated to their lives. Adults share their enthusiasm.

Beyond that, patriotism can drive this program fast and far when it is more widely realized that if America is to remain the world leader, today's kids must learn to think. Time is running out. It is getting very late. The following lessons are offered as a first step.

Aviation as well as education will greatly benefit, locally and nationwide.

METHODS THAT WORK

THESE LESSONS are to add thinking power as well as knowledge. Good teaching makes students listen and remember. But putting information into their minds does not teach them to reason. For this they must be led to inquire and discover for themselves.

Each lesson gives directions for what the teachers and students are to do. Teachers who know the subject can innovate and improve.

Rather than be given quick explanation, the students get questions to discover and find answers with a little prompting by the teacher. They are assigned research in the school library for added facts. They make pertinent experiments to show how natural forces are put to use and are led to think at every step.

For example, students make and fly kites without being told how to and have fun doing it. They are asked to explain the mystery of how some birds can fly without flapping their wings--important in the invention of aircraft.

The lessons do not start with parts of an airplane and how they work, but with inventions that led to modern flight. From kites to balloons to gliders, to powered planes, jets and rockets.

Teamwork - Dividing the class into small groups, so students can work together for research and experiments, is good training. That is how adults work.

A good way is to form teams of four, including one of high ability, two average and one of lesser skill. Each member of a team gets a color at random--red, blue, yellow, or green. When the project ends, students in each color code get together so the findings of the teams are shared by all.

Group leaders should be identified by arm bands when supervision is required, especially on field trips such as airport visits.

Lesson Plans These lessons have been taught to 3rd and 6th grades with equal success and are thought good for all grades. This guide can be a starter program for entire schools and school systems.

It is hoped that a fair number of schools can start in 1992 leading to much larger numbers. An improved version of the first ten lessons will be completed as soon as possible. For the second semester, weather, navigation and other subjects can be taught from existing texts. The way to start is to begin.

SCIENCE PROCESSES

Science processes are necessary for and natural to problem solving and decision making. They should be incorporated in teaching the Airlift hands-on activities.

The eight processes listed and defined below are those to be emphasized. Through multiple experiences, the science processes continue to be a natural method for problem solving not only in science classes but in other life experiences.

OBSERVING: using the senses to gather information about characteristics or properties of objects, events, or situations.

CLASSIFYING: grouping objects or events into categories based upon attributes.

MEASURING: using standard or nonstandard units to describe a quantifiable characteristic of an object or event.

INTERRING: explaining an observation in terms of one's previous experience.

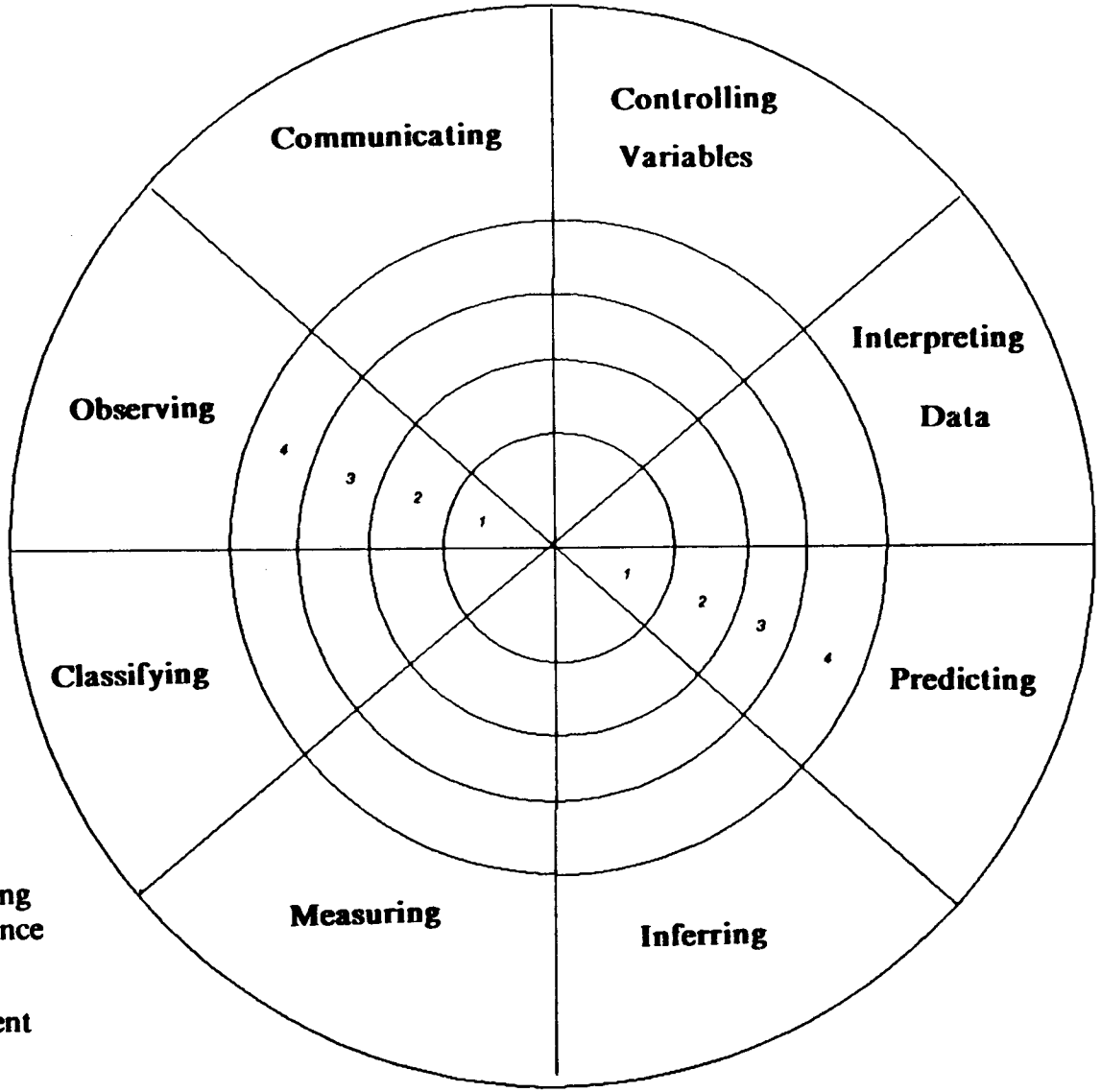
PREDICTING: to determine a probably outcome of a future event using a pattern of evidence.

INTERPRETING DATA: drawing conclusions from organized data.

CONTROLLING VARIABLES: identifying and manipulating the factor(s) which may influence a situation or event so that the effect of a selected factor may be learned.

COMMUNICATING: any of several means for transmitting information from person to person, e.g., graphing models, pictures, pantomime, oral/written reports.

SELF-EVALUATION OF SCIENTIFIC PROCESSES



Key

- Never
- Developing Competence
- Competent

Teacher reviews scientific investigations and discussions with students as they relate to the scientific processes.
Students can self-evaluate their ability to do scientific processes at the end of each marking period.

TEACHING AIDS

1. Office of Public Affairs
   Aviation Education Program
   FAA Headquarters/PA-120
   800 Independence Ave. S.W.
   Washington, D.C. 20591

   Ask for a list of education materials, All Purpose Aviation Councils for American Progress **The Illinois Plan** for Airports and Aviation Education, copies of this teaching guide -- **Airlift for Young Minds** and the use of the Cock Pit Simulator.

2. Center for Aerospace Education Development
   Civil Air Patrol, National Headquarters (ED)
   Maxwell Air Force Base, Alabama 36112

   Ask for the pamphlets on General Aviation and the History Aerospace Personality Series

3. Lockheed Engineering & Sciences Company
   Network Manager Life Sciences Programs Office
   600 Maryland Avenue S.W.
   Washington, D.C. 20024

   Ask for airplane pictures

4. Fantastic Flight
   PO Box 1174
   Fort Payne, Alabama 35967

   Request blueprint plans for Student Airplane Desk

5. Government Printing Office
   Superientendent of Documents
   Retail Distribution Branch
   Consigned Branch
   8610 Cherry Lane
   Laurel, Maryland 20707

   Ask for FAA Education Materials List

6. Local FAA Resource Centers

STAGING DIRECTIONS

Each lesson will be sign-posted to show what the teacher is to do; what the students do, what materials are needed, and other guidelines; abbreviated as follows . . .

T - What teacher needs to know. Not all is told to students at the outset. Let them learn by experimenting, reasoning, and discussion.

TS - What teacher tells students.

Q - Questions to ask students.

A - Answers.

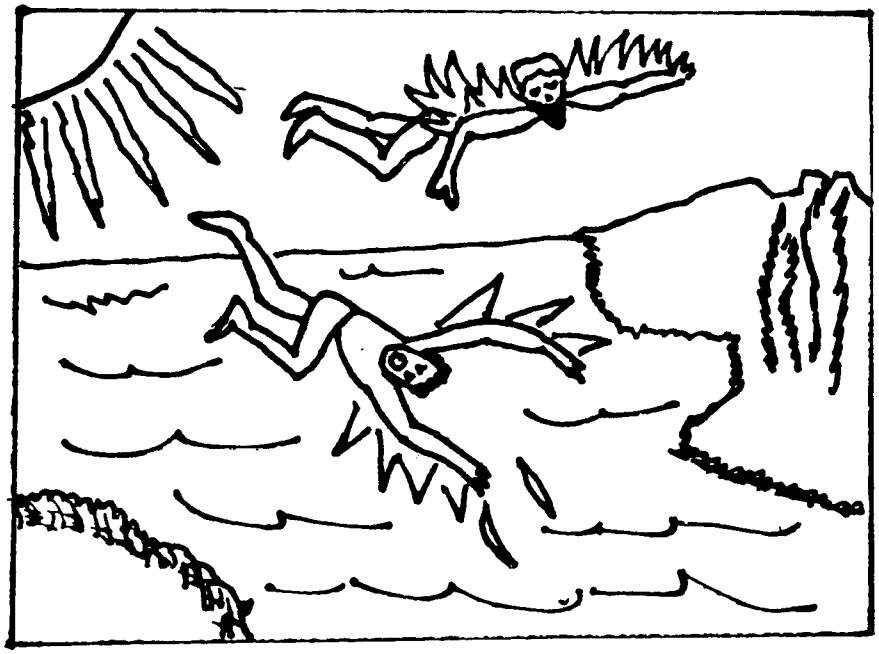
S - What students do.

M - Materials and equipment needed.

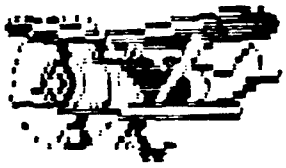
W - Written tests, essays and log books.

R - References: printed, video, etc.

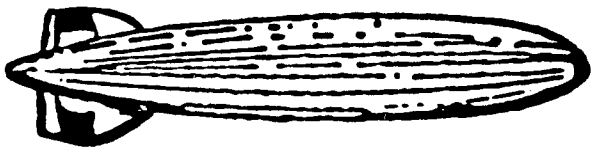
X - Extra curricula trips and activities.



ICARUS AND HIS FATHER



MONOPLANE



DIRIGABLE

LESSON LIST

FROM KITES TO SPACE SHIPS - Human Progress

1 Overview Outline of U.S. civil and military aviation.

(The following are in the order of their invention.)

2 Wings Flapping wings as birds do seemed the way to fly. It did not work for humans except in myths and legends.

3 Kites The first man-made device that flew. A kite can go only as far as the string that holds it in the direction of the wind.

4 Balloons They float free, only with the wind.

5 Gliders Motorless airplanes cannot rise from the ground. Towed aloft and then powered by gravity and the sun's heat, they can be steered but need updrafts to stay up.

6 Propellers Powered airplanes gain speed on the ground before they take off; then can rise and be steered.

7 Lighter-Than-Air Powered gas-filled aircraft can rise and be steered.

8 Rotocraft Helicopters can rise straight up and fly level. Tilt-rotor craft can rise like helicopters and fly level, becoming planes.

9 Jets Subsonic planes propelled by jet engines, blowing compressed air, can fly at nearly the speed of sound, a bit over 600 miles an hour; supersonics much faster.

(The above are airborne; cannot go above the earth's atmosphere.)

10 Rockets They can fly in space where there is no air.

Review Summary and testing for the above.

The foregoing can be taught in one semester. Further lessons will cover navigation, weather science, and other subjects required for flight.

Airport Visit

Career Guidance

LESSON 1 -- AVIATION OVERVIEW

T - Young people have a natural interest in aviation. They start to learn by airline flights and television. Before deeper study, a quick look at the whole complex picture will show how much is there to discover and understand.

T - Introduce "Airlift for Young Minds" with **Picture Interpretation** on page 1.5.

TS - Flight is so important that everyone needs to know how it works and what it means to the world. Study it as if part of learning to fly and you can fly if you wish. Fly or not, what you learn can be useful in whatever you choose to do.

Flight is an American invention. The United States has as many aircraft, airports, and airmen as all other nations combined. Keeping America first depends on young people, tomorrow's leaders, learning about it now.

Aviation has three branches: air carrier, other civil flying (general aviation), and military.

Air carrier - Airlines are the leading mode of travel and the safest. Day and night, big jet aircraft streak across the sky to carry people, freight, and mail throughout the nation and abroad. Replacing rail and bus travel, most of this developed in barely more than 40 years after World War II showed the way to bigger and faster planes.

Q - What is the main advantage of flight? Let students discuss. The answer is speed.

Q - Why? More discussion. People, mail, and freight get where they are going quicker. The less time spent in motion, the more can be spent usefully.

TS - Before there were roads, it took months to cross the continent. Railroads did it in half a week; now airlines in a few hours.

Jet airlines, carrying 100 to 200 people, fly at nearly the speed of sound which is a bit more than 600 miles an hour, fast as a pistol bullet. Flight brings all areas within quick reach.

A few big airlines carry most of the flight passengers between U.S. cities and to foreign points. Several specialized in freight and some in

packages. To connect with smaller cities, regional airlines fly smaller planes, mostly turboprops averaging some 20 seats.

General Aviation - While airline passengers buy tickets as on trains and buses, smaller planes are owned or rented like autos. Big companies, including most of the Fortune 500, have their own fast planes like mini airlines. So their people can fly anywhere directly, not limited to airline routes and schedules. Many lightplanes are used for business and personal travel and for recreation.

Q- What other uses? When you hear a helicopter -- a "chopper" with its pop-popping noise -- what do you think it is doing? Police work. Taking an injured person to the hospital. Watching auto traffic. Etc.

Q - What can light airplanes do? Many services. Spray and dust farms and forest for pest control. Disaster relief. Flight training. Assist in putting out forest fires. Etc.
Many small ultralight planes, mostly home built, fly for fun.

Airports - Planes need space to take off and land. Big airliners need runways more than a mile long; small planes not much less than half a mile.

Q- Why? Let students guess. Big planes need a long run to gain speed; 100 miles an hour or so, for takeoff and to slow after landing.

TS - A big airport is like a city with all services needed for planes and passengers. A landing place for small planes may be only a strip of grass. But all are gateways to the sky and to far places. From your nearest airline field, jets fly at ten times the 55-mile-an-hour limit on autos. A community not near an airport lacks access to the American mainstream, as would one without a railway station a half-century ago. Maintaining and improving airports is a local responsibility.

Safety - Accident rates for hours flown long have fallen for all branches of aviation. To prevent collisions, the Federal Aviation Administration (FAA) controls air traffic at busy airports and aircraft in flight at radar centers across the country. FAA makes detailed rules for aircraft, airports, and pilots. Airlines, aircraft operators, states, and aviation associations plus international groups are at work. Aviation weather reports are provided.

The National Transporation Safety Board investigates accidents to find causes. Aircraft maintenance and repairs are strictly supervised.

Military - Air forces are built to prevent war by making it too costly to enemies or winning it with less cost in lives than in ground combat. Strategic air forces destroy enemy ability to make war by blasting production, transport, and communications by bombers and missles. Tactical forces attack and intercept enemy forces. Air transport carries personnel, equipment, and supplies. Reconnaissance planes and satellites keep watch.

The U.S. Air Force, Army, Navy, Marines, Coast Guard, National Guards, and Reserves keep improving their equipment and skills to stay the world's best. The Civil Air Patrol trains young cadets and flies search missions.

Aerospace - The U. S is the leading producer of civil and military aircraft. The National Aeronauticsw and Space Administration (NASA) sends manned and unmanned rockets into space.

Careers Guidance - Aviation in its many branches provided a great variety of interesting well-paid jobs in the half-century of growth since the start of World War II, not only in busy centers but in small communities and rural areas nationwide. Recessions and the changing world have greatly reduced the need for employees. Young people who hope for aviation careers need to think realisticly of the job outlook to be expected when they reach working age.

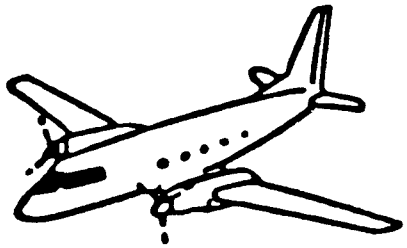
A global boom in the air transport is ahead. Big-city airports and ground services must expand. Air traffic control must keep pace. Military and aerospace employment will decline.

Be practical. To make aerospace work seem glamorous, youngsters are led to pretend they are on the way to becoming astronauts. Fact is that barely dozens will fly into space within the decade.

One thing is sure. If you identify with aviation locally, you will be better able to find job opportunities. Aviation is like a great fraternity with a patriotic motive. While the U.S. total of general aviation (private and corporate flying) is not expected to grow in the 1990's, there is no limit to what an air-minded community can do. And you can learn to fly as you

learn to drive. Keeping the spirit of aviation strong in every hometown can keep America first in the air.

W - Write a brief essay on the branches of aviation and the services that each performs. Have the best ones read aloud to the class.



PICTURE INTERPRETATION

Introduction to Aviation Education--Airlift for Young Minds:

M - Picture with an airplane in it.
Construction paper.

T - Obtain a picture with an airplane in it for the purpose of revealing objective of studying aviation.
This will be a higher order thinking skill to encourage verbalization.

Cover up picture with construction paper placed over parts of the picture. Slowly reveal the picture by uncovering it part by part while asking the following questions:

A - Accept all answers because this is an invitation to students to use their imaginations.

Q - What do you think this part of the picture is?
What is it? Where do you think the picture takes place?
What happened one hour before this picture? What will happen in one hour? Who are the people who took this picture?
Where were they when they took the picture?

TS - Reveal the plane last? Before revealing the plane, ask students what they think is behind the last part of the picture?

T - Unmask all of the picture.

Q - Where is the plane going?
Where did it come from?
Who is in the plane?
Why are they in the plane?

TS - Students are going to be studying about aviation education. They will find out the history of aviation and they will also find out why a plane can fly. Many hands-on investigations will be performed by students to find out the answer.

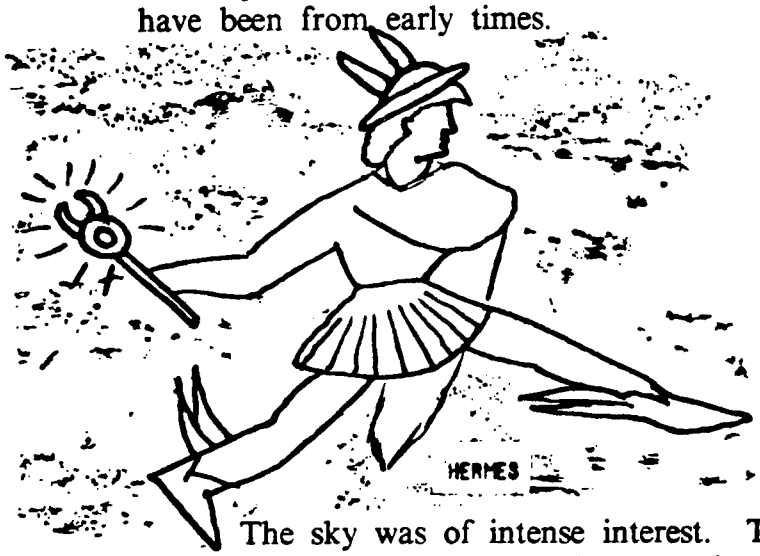
X-Hang picture in the room.

LESSON 2 - WINGED LEGENDS

TS - MYTHS AND LEGENDS about flight were told ages before anyone flew and are so unforgetable that they have come down to us through the years. They did not lead men to fly, but planted ideas about the wonders of flight that remain deep in human minds. So we begin the account of how flight began with some of these stories. Further lessons will trace inventions step by step from kites to spaceships.

It is said that the urge to fly came from watching birds. But little was learned from our feathered friends. Birds and insects fly by flapping their wings to push against air. No machine has flown that way. Other ways were not tried till only 200 years ago.

Only gods could fly without wings by means unstated. Men flew only in dreams. Have you ever dreamed you could stretch out your arms and fly like Superman? (Show of hands.) This is a common dream now and could have been from early times.



The sky was of intense interest. That was where the gods lived. Towers were built to come closer to the stars. Atronomy advanced. So did astrology, assuming that stars influenced life on earth. Had our forefathers given more thought to earthly science, they might have discovered flight principles which are simple.

Had you lived in early times, you would have thought the earth was flat and unmoving. Close above, the sun moved by day; the moon and stars by night. Between the stars and earth, the air, invisible but strong, brought rain and was the breath of life. All was directed not by natural forces but by gods and unseen beings. If you thought otherwise, you kept quiet or would be in trouble.

It is story time. We see the world as it was before the dawn of history.

GODS AND ANGELS

Flight was more than human. Air was a mystery. It was invisible, yet had power and was the spirit of life. Only gods flew without wings to flap through the air. By some magic, they went as they pleased, visibly or invisibly. They carried no loads except that the Norse Thor hammered thunderbolts aloft. You can see Thor's anvil atop thunderclouds.

Others used birds or winged beasts. The Greek god Apollo drove Pegasus, his horse, to haul the sun each day across the earth which everyone could see was flat and motionless, not suspecting it was round and turning.

It is told heaven is up and hell is down. Heaven is staffed by angels, pictured with feathered wings. The fires of hell are stoked by devils, said to have leathery wings, batlike.

Devils who might give flyers a bad name now are seldom mentioned. Winged angels give the idea that flight is for the beautiful and good.

Angels had spectacular vehicles. The last ride of the holy man Elijah was in grand style. "There appeared a chariot of fire and horses of fire and Elijah went up by a whirlwind into heaven."

Some of the chariots of fire in all tales, some think, were space ships from other worlds. Frequent reports of Unidentified Flying Objects (UFOs) make this seem possible.

The Book of Revelations in the Bible, looking to the future, told of flying monsters. One was like the 6-engine B-36 bomber, first sky giant plane with global range. "The beasts had each six wings and eyes within and they slept neither day nor night."

Ancient sculptures show how it was thought winged beings might look. Most beautiful is the Winged Victory statue of a woman with head missing, found in the sea. (Show picture.)

Q - Had the Victory come to life, could she have flown? She needed her head, of course, to look ahead and fly safely. (Discuss.)

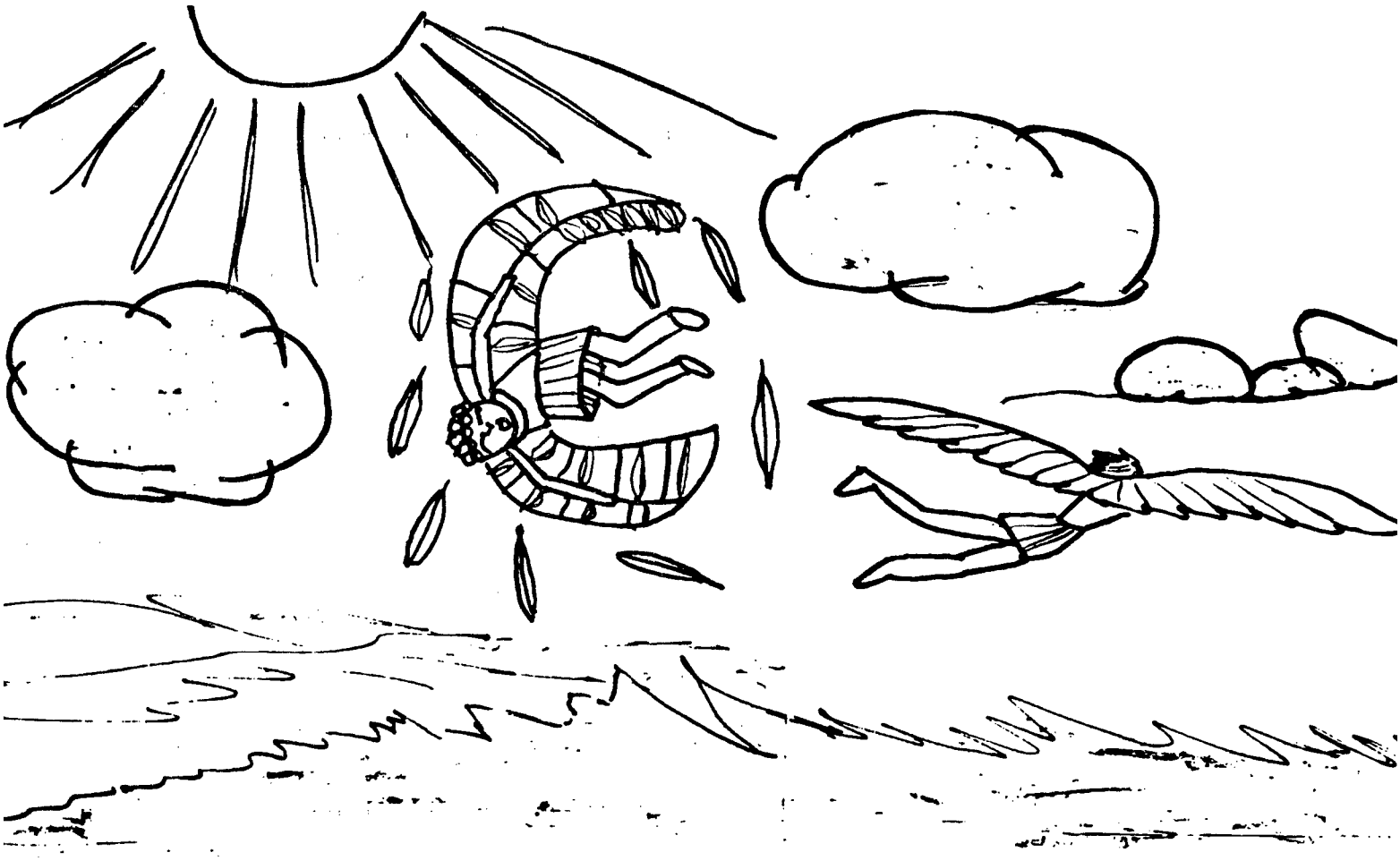
WINGED VICTORY

TS - The Victory could not have flown. Her wings were not big enough and muscled enough to flap with enough lift. A bird's wings are as long as its body--well muscled in front. You can see this when you eat breast of chicken.

FEW MEN FLEW

Few of the old tales are about men flying. Perhaps it seemed impossible to believe. And the gods did not want men to rise too close to heaven as shown when the Tower of Babel was being built too high. It is said that a god confused the builders by causing them to speak different languages.

The Greek youth Icarus came to a bad end. He was in exile with his father who, to escape, made wings which attached to their shoulders with wax. Thrilled with flying, Icarus skylarked wildly as modern pilots are warned not to do. His wings came off and he fell into the sea. The Mount Olympus board of inquiry, seeking the cause of the accident, as modern investigators try to do, found that Icarus flew too high so the sun melted the wax that held his wings on.



ICARUS AND HIS FATHER

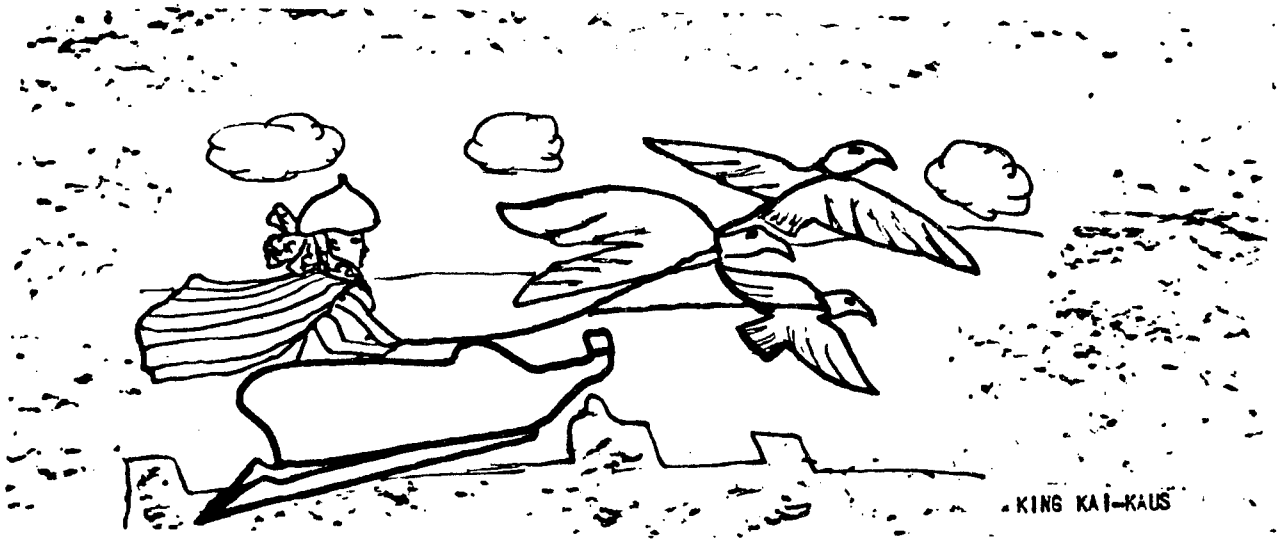
Q - Could this have happened that way? Discuss. The higher air is cooler rather than warmer so the wax would not have melted.

TS - The hindu God Vishnu is pictured as riding a bird named Garuda and throwing a discus at enemies, a forerunner of aerial combat. A man impersonated Vishnu by flying a model of the big bird to a beautiful princess. Blessed by such a visitor, her father stopped paying taxes to the top king who then declared war. The gods, rather than let Vishnu seem to be defeated, gave the man and wooden bird power to win the battle.

In America, Indians told that Hiawatha came to New York State in a white canoe, made peace between warring tribes, and left skyward in his canoe with heavenly music. Fact is that, given peace and plenty, the Iroquois Federation became highly civilized but did not forget how to fight and kept the French from moving in.

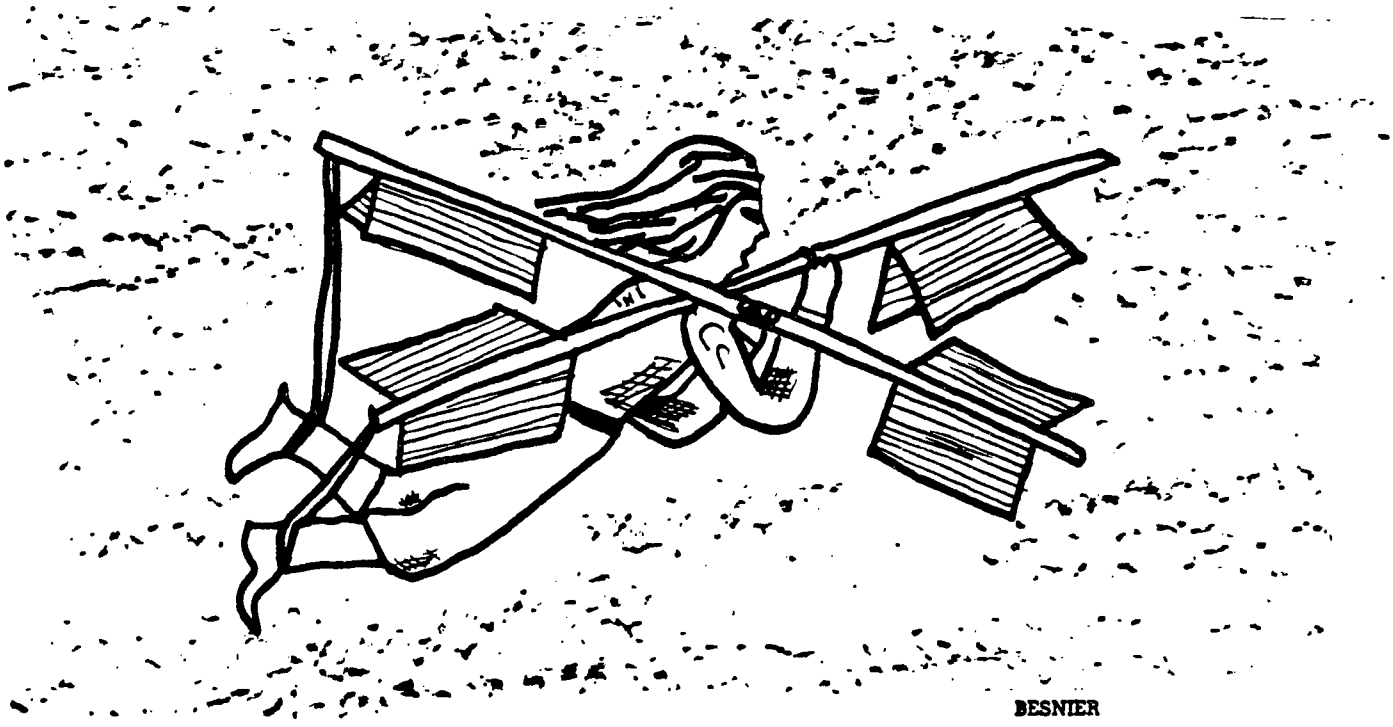
In the West, Indians thought that thunderstorms were brought by the Thunderbird.

An ancient Persian legend tells that King Kai-Kaus was carried on his throne by captive eagles. A Chinese emperor was said to have put rockets on his throne and blasted off, never to be seen again.



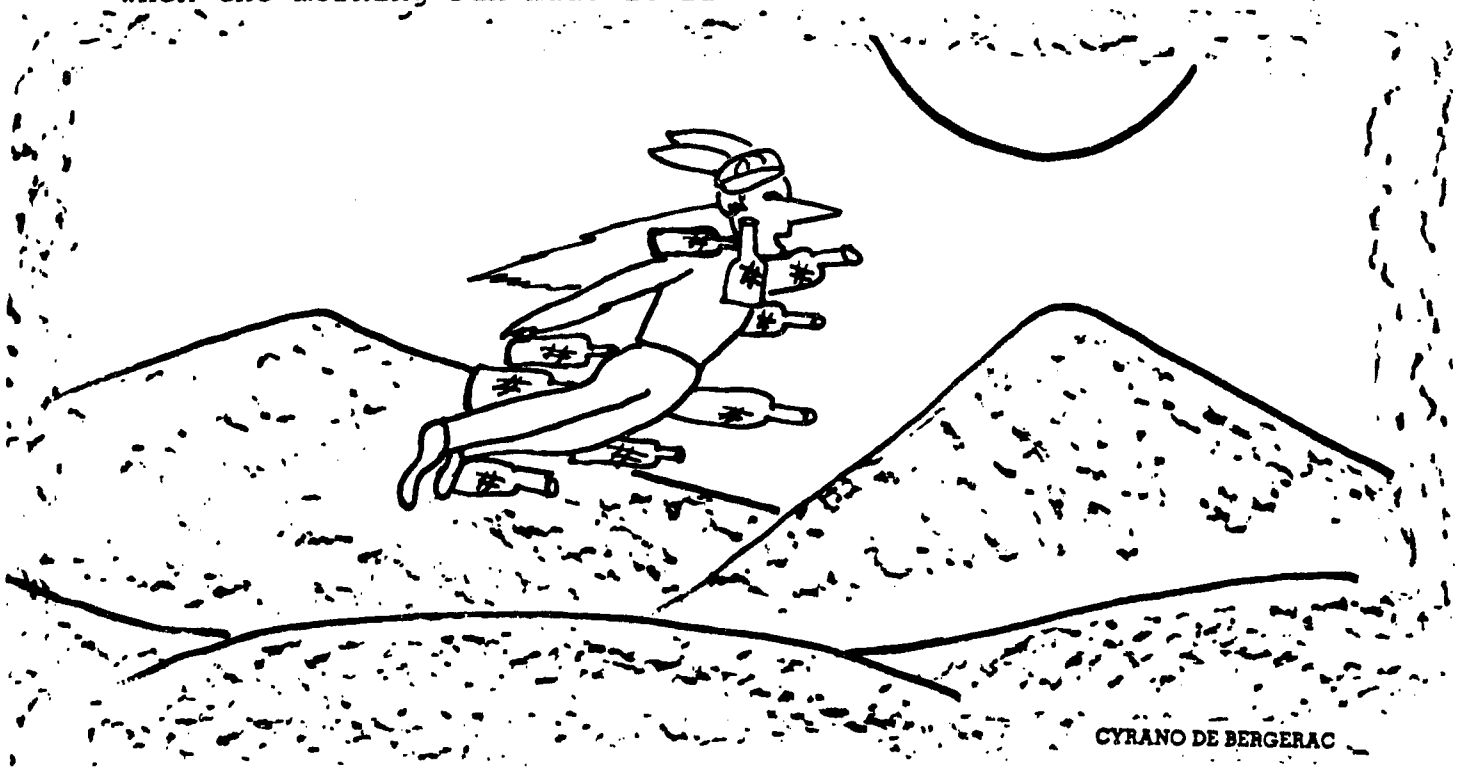
In Arabian tales, huge birds called rocs could carry a man. Flying carpets of unknown propulsion and guidance were used for travel.

Besnier, a French locksmith, claimed to have flown with a device driven by his arms and legs. As each sail-like part moved up, it came together to minimize air resistance. On the downstroke, the folded parts opened to push against the air, much as a bird's wings do. In recent times a bicycle-type machine took off by man power.



BESNIER

Cyrano de Bergerac, the long-nosed Frenchman, wrote of ascending to the moon with bottles of dew which lifted off when the morning sun made it rise.



CYRANO DE BERGERAC

Witches in the Middle Ages were said to fly on broomsticks. In an ancient Greek novel, a witch used magic ointment to become a bird and fly. A man who watched, used the wrong ointment and turned himself into a jackass as so those who try to fly without knowing how.

A few churchmen in Europe were said to have flown like Mary Poppins, feigning some claim to sainthood. Some cases of rising by levitation are alleged but there are no videos to prove it.

T - The point of reviewing old legends is that they continue to influence attitudes toward flight beneficially. (Explain in words that students will understand.)

MODERN TERMS

TS - What people think comes not only from current knowledge but from ideas that have accumulated in human knowledge through the ages. Much in the world's religious beliefs is many centuries old. Same for flight. Until the present century, since no one had flown except in balloons, ideas about flight could come only from legends, fiction, and guesses.

Since flight began, much technical and practical knowledge has been added. The old concepts are deeply imbedded and slow to change. Heaven still is up though you may be told only empty space is there. Angels have wings. Though you never see any, you know how they look and equate these flying beings to goodness.

The most cherished dream of children is Santa Claus with presents in a flying sleigh drawn by reindeer. Though adults do not think him real, his spirit of giving lives.

Good thoughts for imagined flight remains strong since it became real. Other industries spend large sums finding and changing what people think of them, not always truthfully and some ones harmfully as in trying to sell young people on smoking and drinking more. Aviation won approval on its merit, offsetting fear of flying and objection to noise.

New wonders to come are previewed in science fiction as in Jules Verne's books of the past century now partly true, and now in comic books, movies and television. Superman's flights, though not possible, and Star Trek which may partly be true, are popular both with youngsters and adults. Yesterday's fables and today's imaginings point the way to tomorrow's progress.

R - World Book Encyclopedia

NAME_____

WINGED LEGENDS

EXAMINATION

1. Why do you think man developed winged legends?

2. Icarus flew too close to the sun. Why is the result actually impossible when considering nature and natural forces?

3. What else would you like to know about winged legends?

LESSON 3 - KITES

T - This lesson begins to show how lift is given by the force of air in motion. This is the means of all airborne flight except balloons. A kite is held by a string to slant against the wind so the air pushes under it. For airplanes, the air sucks above the wing but this will be left for later lessons. Without the string, the kite is not held against the wind so there is no lift and it falls.

The motion must be fast enough to give enough lift. On a still day, a kite can not be flown by someone standing on the ground. But if the kite is pulled at the speed needed for lift, the motion against the air will fly it, same as if the wind blew that fast. Motion of air relative to the kite rather than to the ground causes lift.

If a kite needs a wind of 15 miles an hour to fly and the wind is only 10 miles an hour, a person can run with it 5 miles an hour against the winds, the kite will move 15 miles an hour relative to the air and will fly. If s/he runs downwind, the airspeed relative to the kite will be only 5 miles an hour. Kites, gliders and airplanes take off into the wind.

Children trying to fly kites, not told what to do may run with them in all directions. By trying, they can learn to run upwind. For a kite to fly, the string must be attached with a double hitch at the right place in the front of the kite. (See diagram--pg. 3-4.) A kite tail must be long enough to steady the kite and keep it right side up. These things can be learned by trial and error in making and flying kites without detailed instructions. The aim is not just to teach but to stimulate thinking and learning, having fun doing it.

TS - Kites were the first man-made devices to fly. They are simple but much can be learned from them. They fly not by flapping wings as the birds do, but by the force of air in motion. Learning this is the first step toward learning how airplanes fly.

To see how this works, stick your hand out the window of a moving auto. Tilt your hand against the air and feel the upward push. The same would happen if you were standing still and tilting your hand against a strong wind. This tells you that air is not empty space. Though invisible, it has force when in motion.

History - Kites of many shapes, with or without tails, were made of paper or cloth on light frames and held by cord or wire, beginning long before Christ, mostly in Asia. In some countries, they had religious meaning. Or they carried reeds that made a musical noise in the wind to scare evil spirits.

Since kites can fly only the length of the string in the direction of the wind, their practical use is limited. Ben Franklin flew a kite in a thunderstorm to prove that lightning is electric. It is doubted that he could have done so in this way.

In the last century, kites were used for weather observations such as air pressure aloft. By hitching several kites in tandem, altitude over 4 miles was reached. Small balloons now are used.

Military uses have been few. In China, a man is said to have been carried over a highway. Kites have been used to lay torpedos. A century ago, kites big enough to carry a man were flown experimentally. Aircraft have made such uses obsolete.

R - Encyclopedia Britannica is source of some of the above under the heading of Kite Flying.

PRE-KITES

T - Organize students in small groups -- 3 or 4 to a group. This is a time for cooperative learning in groups. The groups should be arranged by ability--one student of high ability, two of average ability and one student of lower ability. In this way, students can all benefit from eachothers knowledge and skill.

M - String (18 inches long), paper lunch bags, long pieces of paper (tail), hole punch, lab books, chart paper/magic marker

T - Place pieces of string, paper bags, long paper strips, hole punch, scotch tape

TS - Teacher tells students to make a pre-kite with items

S - Students make pre-kites and then share with small groups the designs they have completed.

W - Predict if pre-kite will fly.

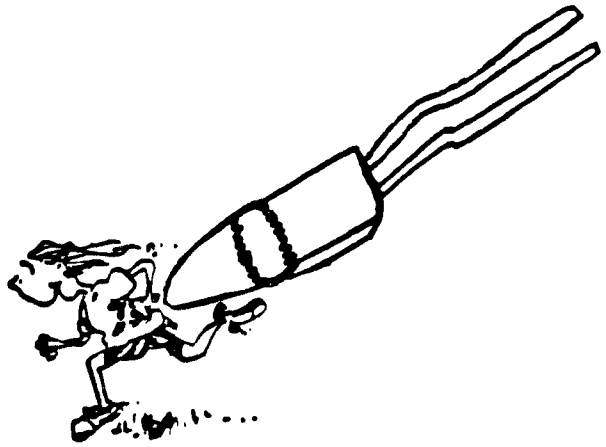
S - Go outside and fly pre-kites.

W - Write what happened when flying pre-kites.

Q - Ask students what they discovered when they flew pre-kites.

T - Chart student responses.
1. Run into wind to raise pre-kite.
2. Have long tails to steady pre-kite.
3. Place string at opening of bag to allow kite to fly smoothly.

X - Hang pre-kites on a bulletin board.



KITES-Discussion

The following is a discussion prior to actually making a kite.

T - Arrange students in work groups -- 3 or 4 to a group

M - Chart paper/magic markers or
Blackboard/chalk
Log books

Q - How can you make a kite?
Call on several students for their ideas--Accept all answers.

Q - What shape would fly best?

Q - What materials would you ned to make the kite?

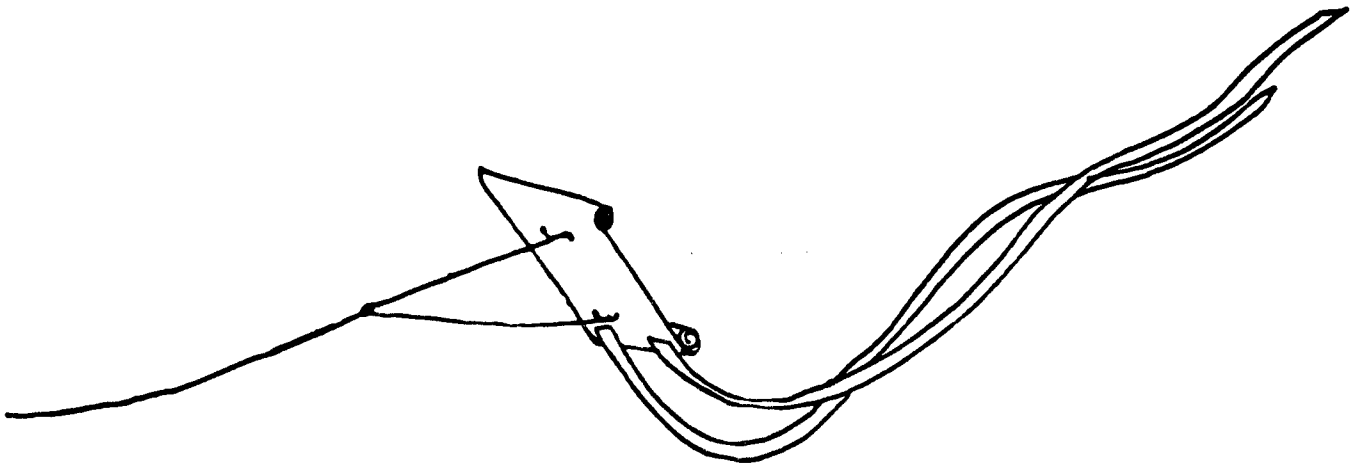
T - Write the same 3 questions on the blackboard or on chart paper.

TS - Teacher asks students to write their responses in the lab books.
1. How would you make a kite?
2. What shape would you design you kite?
3. What materials would you need?

W - Students write responses in log books.

S - Students read their responses in their small groups.

S - Teacher calls upon several students to describe their design.



KITES

STRAW KITE DESIGNING AND CONSTRUCTION

T - Teacher shows students a variety of pictures of completed paper kites. Explain what they are made of and discuss how they could have been constructed. Examples are shown. Actual store bought kites can be shown to students and their construction discussed.

M - 3 straws per student (as needed), kite string, white paper (8 x 11), construction paper, scotch tape, hole punch, pencil, long strips of paper, paste, stapler, scissors.
Log book.

TS - Tell students to make a kite based on their own design or change design if the student decides to.

TS - Remind students that kites will fly better if:
1) Kites are light weight.
2) Kites should have long tails for windy days.
3) A long string will take the kite high in the air.

S - In small groups, discuss how students have made kites. Have several students share their completed design with the class. Students should describe why they made kite the way they did and why they think it will fly well.

W - Students predict if kite will fly and why.

TS - Teacher tells students to go outside on a windy day, for best results, and fly the kite.

W - Write down in lab books the result of their flying of kites and why it flew the way it did.

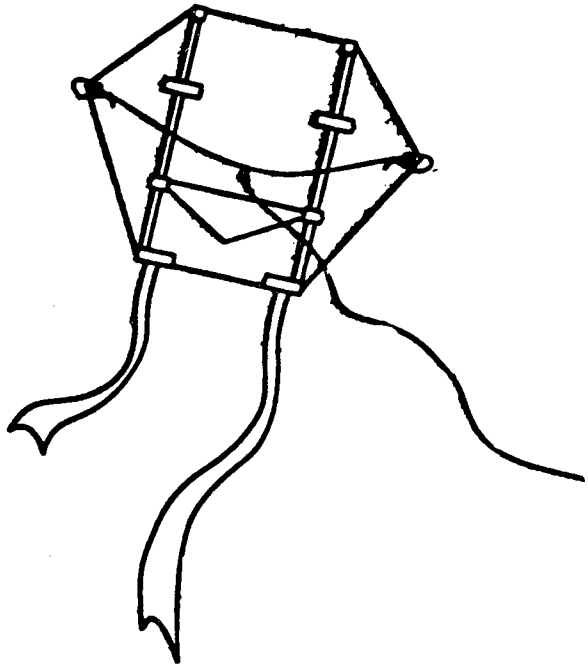
X - Make a bulletin board of the kites.

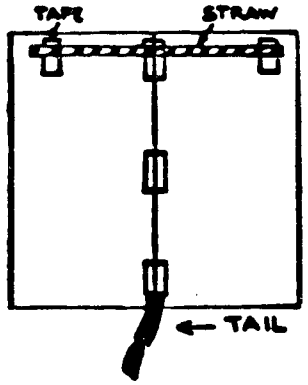
X - Have students bring in store purchased kites. Fly them outside.

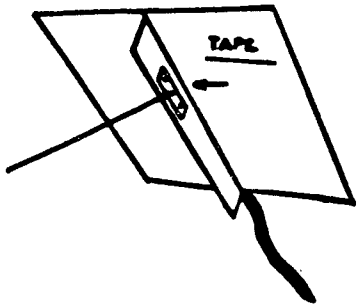
W - Small groups discuss the characteristics of Pre-Kites, Self-Make Kites, and Store Kites.
Record characteristics in log books or on COMPARISON OF KITES (Similarities and Differences)

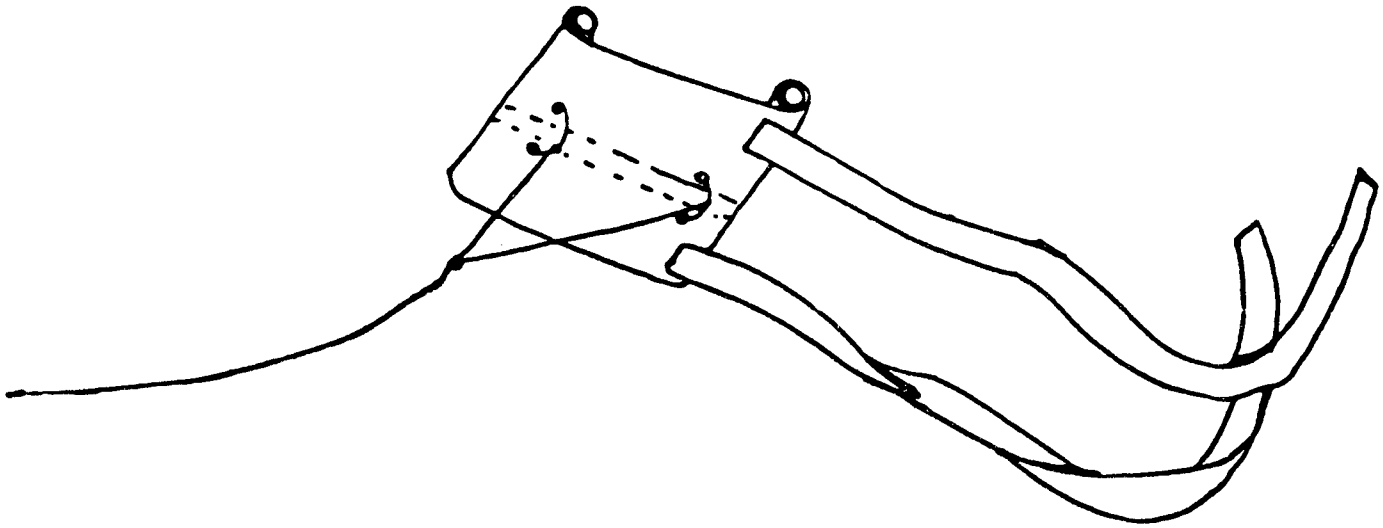
Kites

STRAW KITE EXAMPLES









NAME _____ GROUP _____

3-7

COMPARISON OF KITES

SIMILARITIES

PRE-KITES	SELF-MADE	STORE KITES

NAME _____ GROUP _____

COMPARISON OF KITES

DIFFERENCES

PRE-KITES	SELF-MADE	STORE KITES

KITE EXAMINATION

M - Pre-printed exam

T - After pre-kite and kite flying activities have been completed, have the students complete the examination. Answers should be based on their first hand experiences.

1. Which way must you run to lift a kite? Tell why?
   (Answer--Run against the wind at the speed of the wind to attain lift. Or--Stand with kite against the wind to catch wind to lift the kite.)

2. What is the reason string is attached to the kite?
   (Answer--String holds kite against the wind freely so that lift can be attained.)

3. Draw a design of a kite.

NAME_____

KITE EXAMINATION

1. Which way must you run to lift a kite? Tell why?

2. What is the reason string is attached to the kite?

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NAME_____

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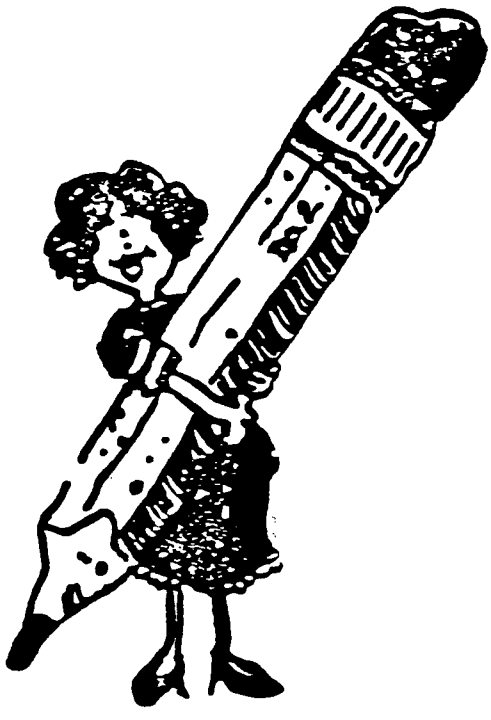


R E S E A R C H

T - Before proceeding to Lesson 4 on Balloons, you might want to have your students research the history of Leonardo Da Vinci, Montgolfier, Lilienthal and gliders, and Zeppelin and dirigibles as they relate to aviation.

R & W - Cooperative learning The class is divided into groups of four and each student in the group is given a different color card. Each group does research on one person. That group is now an "expert" on that one person. Each group of 4 is given a different person to research. After their research is complete, they change to color groups and share the information. Record information on the "Airlift for Young Minds" ditto.

NAME _____ GROUP _____

AIRLIFT FOR YOUNG MINDS

LEONARDO DA VINCI

MONTGOLFIER

LILIENTHAL GLIDERS

ZEPPELIN DIRIGIBLE

LESSON 4 - BALLOONS

HISTORY - TS - A hot-air balloon was launched in France by the Montgolfier brothers in 1783. This was the start of manned flight unless you count the theory that balloons were flown for religious purposes in ancient South America. The brothers observed the rise of clouds and chimney smoke. They decided that smoke would make a bag rise. They found that heated air is what rose.

So they made a linen bag 33 feet in diameter, painted it with bright colors and sent it on a trial ascent. Then they sent up a duck, a rooster and a sheep. They returned intact except that the rooster, kicked by the sheep, suffered an injured wing, the first casualty of flight, unless you count Icarus. So then a man risked the flight. It worked.

Benjamin Franklin was America's ambassador to France when he saw a manned balloon fly. He said not a prince could be secure in his domain when armies could drop from the sky. With the same idea, Napoleon assembled balloons to cross the English Channel but did not find it practical to give the order to attack.

Gas came into use to inflate balloons since hot air shrank and lost its lift when it cooled. Modern hot air balloons have burners to reheat air.

Balloons became a subject of fiction. Writing about an imagined aerial trip, Edgar Allen Poe foresaw that long flights could be boring. Jules Verne wrote of a balloon blown to a Pacific Island in Mysterious Island.

Observation balloons were used in the Civil War and World War I, also for air defense screens in World War II. Small balloons give weather data. Now balloons without propulsion are used mostly for sport, bungie-jumping and occasional stunts such as ocean crossings. The story of powered lighter-than-air craft is for a later lesson.

An ill-fated attempt was made to cross the Arctic region from northern Canada. The bones of the crew were found years later on an island north of Europe.

How It Flies

Q - How does a balloon rise? (Let the class reason it out.)

A - The hot air or gas inside is lighter than the air outside. That is why the balloon floats. The heated air is expanded. The air inside is lighter than the air outside the balloon, in the same way a block of ice floats because it is expanded and therefore lighter than water.

Let's compare the two. Ice takes up more space than an equal weight of water so it floats partly above water. The weight of the greater part below water is equal to the weight of water it displaces.

Air weights 14.7 pounds per cubic foot at sea level at normal temperature. When heated and expanded, it is lighter. The lifting power of a balloon is equal to the difference between the weight of the hot air or gas inside and the weight of an equal volume of air outside.

If you have figured that out, you did better than anyone ever, until 200 years ago.

Air rising from the sun's heat gives lift to gliders, as told in the next lesson. And it causes clouds to form.

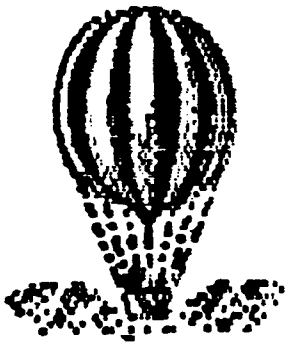
Q - Why does a balloon stop rising and not keep going to the moon? You might know that from what we just learned.

A - The air is thinner aloft, the higher the balloon goes. When the weight inside is the same as an equal volume of air outside the balloon, ascent stop. When lift is reduced by cooling of the heated air or escape of gas, descent begins.

Q - How can descent be stopped? This will test your ingenuity.

A - Lighten the load. Balloons carry bags of sand to put out. Modern hot air balloons have burners to keep air hot.

R - Encyclopedia Britannica under "Balloon".



PRE-HOT AIR BALLOON ACTIVITIES

T - Students will conduct hands-on activities to discover what lighter than air really means. Then they will understand why a hot air balloon can lift off the ground to soar into the air.

ACTIVITY 1:

M - 2 Helium balloons, log book

TS - Observe the helium balloons. Look at them and touch them.

Q / W - Why do you think the balloons float? Record observations in log book.

A - Helium is a gas which is lighter than air.

ACTIVITY 2:

M - Balance Scale, 2 balloons of same size, log book.

S - Place balloons on scale so they balance. Take one balloon and blow it up. Replace it onto the balance scale.

Q / W - What do you observe? Record observations in log book.

A - Blown up balloon falls because the air in it has weight.

ACTIVITY 3:

M - Glass soda bottle, balloon, bowl of ice cubes, bowl of boiling water.

S - Place a balloon over the lip of a soda bottle.

S - Place the bottle into a bowl of boiling water.

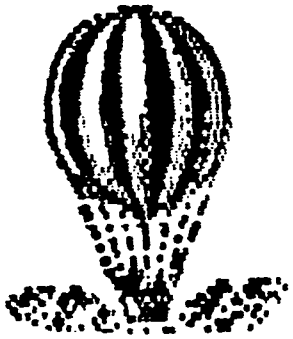
W - Write what you observe in the log book.

S - Place the bottle into a bowl of ice cubes.

W - Write what you observe in the log book.

TS - What are the results?

A - When air is hot, the molecules of air expand and rise. When air is cool, the molecules of air contract and fall.

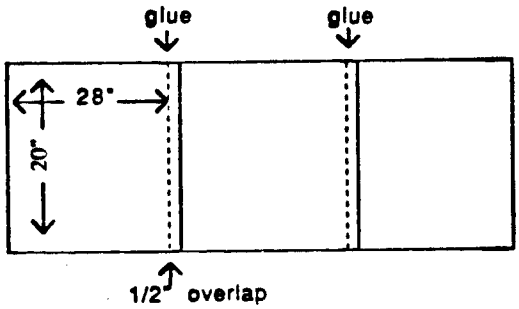


HOT AIR BALLOON--CONSTRUCTION

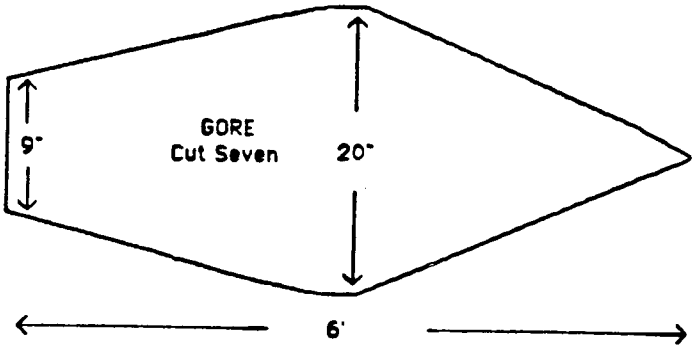
M - Tissue paper sheets (20" x 28"), rubber cement, string, masking tape, dowel.

TS / S - Hot-Air Balloon Construction

1. Carefully glue three sheets of 20" x 28" tissue paper together lengthwise. Overlap each sheet 1/2". Use rubber cement.

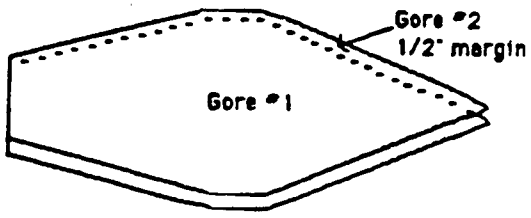


2. Repeat step one 6 times. Stack the seven 84" long sheets of tissue. Draw the shape of the gore on the top sheet using the diagram below.



3. Cut out all seven gores at once using the top sheet as a guide.

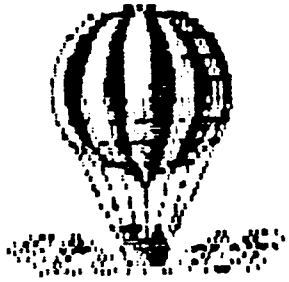
4. Stack gores. Slide top gore #1 about one-half inch to the side of gore #2. Fold the one-half inch margin of gore #2 over gore #1. Glue the margin of gore #2 to gore #1.



5. Slide gore #1 and #2 to the side of gore #3. Leave a one-half inch margin. Fold the one-half inch margin of gore #3 over gore #2. Glue. Repeat this procedure with gore #4, #5, #6 and #7. Finally, glue gore #7 to the free edge of #1.

6. Gather the top of all seven gores (small opening) and tie with string. Make a loop in the string.

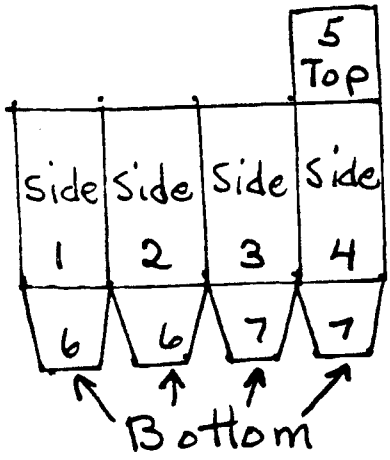
7. Bind the tissue paper at the bottom (large opening) of the balloon with masking tape. The masking tape reinforces the bottom edge of the balloon.



ANOTHER HOT AIR BALLOON DESIGN

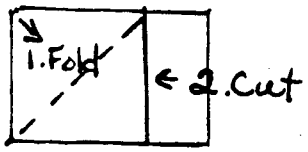
M - 7 sheets of tissue paper, 18" wire, glue stick, scissors, camp stove, heat mitts, coffee can

TS / S - Tissue paper Hot-Air Balloon Design
Top - 1 sheet
Side - 4 sheets
Bottom - 2 sheets

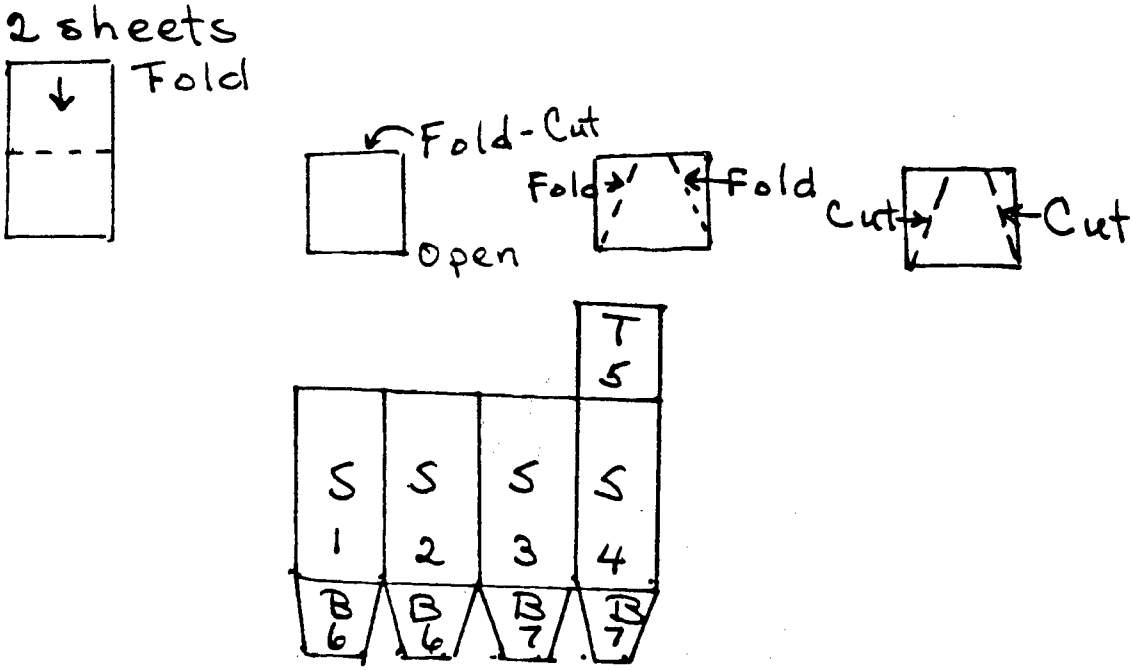


TS - S - Assembly
1. To make the side panels, glue three side panels with 1 " overlap.

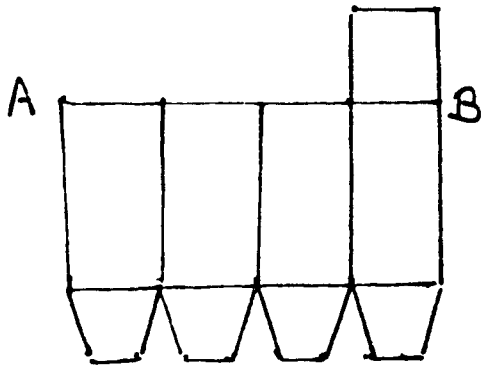
2. To make the top, make a square from the 5th piece of tissue paper. Glue the top to one of the ending side panels with 1 " overlap.



3. To make the bottom, cut the 6th and 7th sheets in half. Form trapezoids and cut. Glue to the bottom of each side panel with 1 " overlap.



4. Glue side A to side B allowing 1 " overlap.



5. Glue the remaining 3 sides of the top section to the 3 remaining side panels.

6. Carefully overlap adjacent trapezoids, and glue them together.

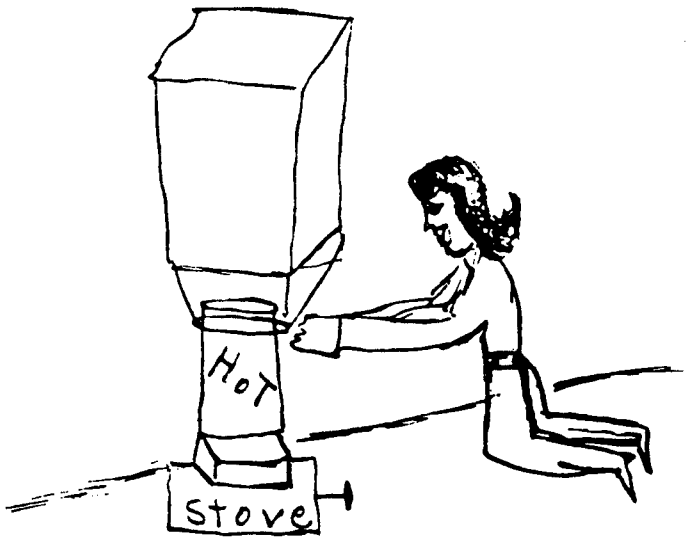
7. Form a wire ring, from the wire piece.

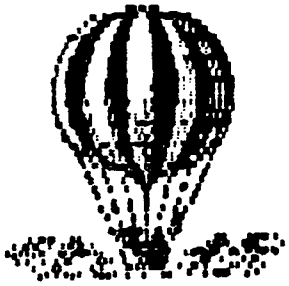
8. Place the wire in the mouth of the balloon, and carefully gather the tissue while folding it over the wire.

9. Glue the gathered tissue to keep the ring in place.

10. Let dry.

11. **LAUNCH !!**





HOT AIR BALLOON

--LIFT OFF

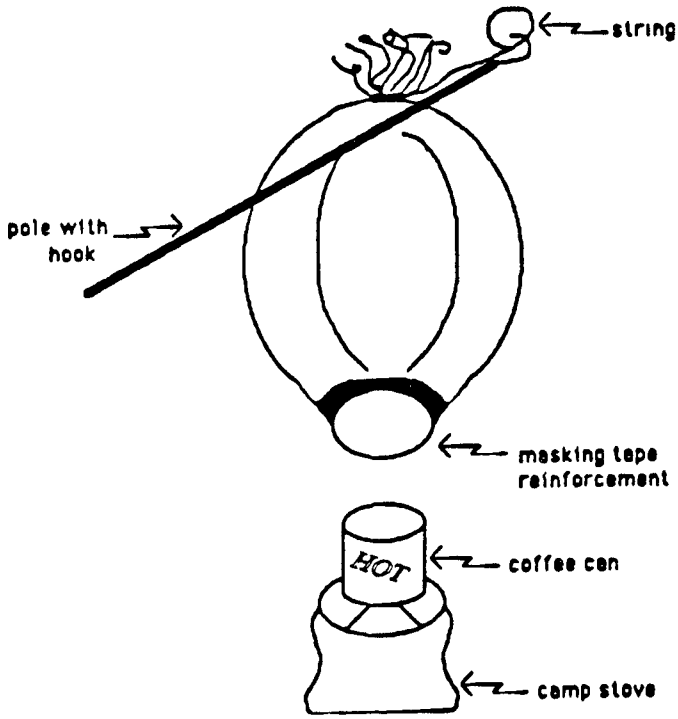
M - Fan, 2 hair dryers, 2 stacks of books (1 foot tall), log books and/or Hot Air Balloon Launch ditto sheet.*

TS - Teacher ask the students to predict if the Hot Air Balloon will rise and why. Record prediction into log book.

S - Four students position the masking tape side of the Hot Air Balloon over the fan. Turn on the fan. The air will fill the balloon.

S - Give 2 students the hair dryers. Blow the hot air into the Hot Air Balloon.

S - Students observe and record their observations in log books.

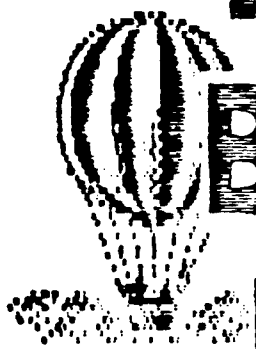


*Note: Instead of the camp stove, use the fan first to blow up the balloon. The fan should be placed sideways on several stacks of books to allow air to flow. Use the heat from the hair dryers to raise the hot air balloon. Use of a hot air popcorn maker makes the hot air balloon rise also.

Name_____

Period_____

HOT AIR BALLOON LAUNCH

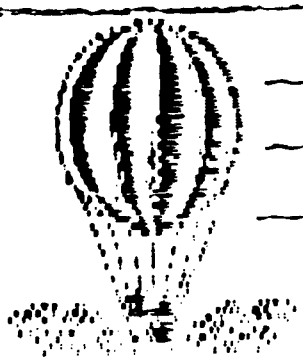


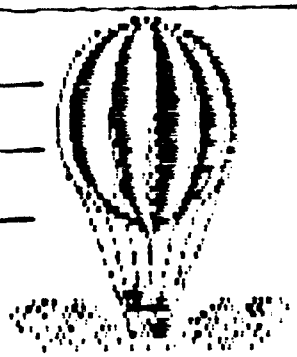
Materials:

Prediction: Will the Hot Air Balloon lift off the ground? Why or why not?

What happened?

Results:





LESSON 5 -- GLIDERS

T - A kite can fly but cannot move about. A balloon floats free but cannot be steered. A motorless glider can be steered but can not rise from the ground. Add a motor and it becomes an airplane free to take off and fly.

But how can it fly without a motor? Students discover that it glides forward by forces of gravity and rises to float by the heat of the sun.

TS - A man cannot fly by attaching wings and flapping them like a bird. Human muscles are not strong enough. The story about a Greek boy named Icarus who flew in this way, could not be true. Had his dad watched birds more, he and his son might have flown.

Some birds, after flapping into the air, can fly with wings outstretched and no longer flapping. A man can do the same with a light frame like a pair of wings or can ride in a motorless airplane, called a glider because it glides through the air.

After learning about kites and balloons, you should know what makes a glider fly. (Teacher throws a dart made of folded paper. It flies a short distance and falls.)

Q - Why did it fly a little? Why did it fall? Remember what you learned from kites and balloons. (Discussion brings out that the wind must be strong enough to lift the kite. Same with the motion of a glider through the air. If less than at "stalling speed", the glider goes into a nose-dive.)

Examples of short flights can be found in nature. A flying fish, to escape danger, leaps from the water and glides with fins like little wings. A flying squirrel stretches the skin between fore and hind legs on both sides to go like a living glider from tree to tree.

Forward Action - A seagull can rise from the ground or water and soar without further wing movement. A buzzard can soar hour after hour. An albatros, an awkward "gooney bird" on land, hardly able to take off, flies gracefully for great distances without effort. If it had to flap its wings it too would tire.

Q - What gives forward motion to a bird without use of muscle power or a glider without a motor? What happens when a glider leaves the ground, pulled by a cable or towed by an airplane, and released?

(Discussion indicates that if pointed too steeply upward, it will lose speed, stall, and nose-dive. If pointed downward, it will gain speed and fall. Between moving too slowly and too fast, if tilted slightly downward, it will fall at a speed to make the air support its weight. So it slides through the air by the force of gravity.)

Vertical Motion

Q - Why doesn't it keep falling till it reaches the ground? To keep it aloft, some other natural force must be working. Can it be wind?

(Discussion shows that when a glider is airborne, it moves no matter whether the air is still or moving in relation to the ground.)

So if the air is rising, the glider rises with it. We know that air expands and is lighter when heated. We have seen it lift a balloon. Sunlight heats air which is continually moving.

The air keeps moving with updrafts and downdrafts as well as winds. A skilled glider pilot looks for updrafts and can go far before having to land. Lacking an engine, a glider is light and lands at slow speed. A bird rides the thermals in ways unknown and can flap to gain altitude.

Controls and Instruments - A glider is steered like a boat or an airplane by a rudder hinged at the tail. Turn it to the right and the air pushes the tail to the left so the glider turns right. To point the glider upward or downward, a similar horizontal flap on the tail hinges up or down. The rudder is turned by foot pedals and the elevator by a lever known as the stick.

A compass tells the pilot the direction of flight. A simple air speed indicator tells when the glider goes too slowly and is in danger of stalling.

In another simple instrument called a altimeter, a green pellet rises when the glider is gaining altitude and a red pellet when it is descending.

History - Obvious as all this may seem, it was not until the 1800's that experiments with gliders began.

> British scientists flew models and developed theories in the 1800s. Otto Lilienthal, a German, with his brother made the first manned flight -- except for balloons -- by putting a glider on his shoulders and landing on his feet. He was killed. He learned by watching birds. He designed cambered wings with curved upper surface.

Thus the air has further to go across the top than the bottom of the wing. Air moving faster has less pressure. This rather than the thrust of air under the wing, causes lift. It does not take much difference in air pressure per square inch to support the weight of the aircarft since there are 144 square inches in a square foot and many square feet in an aircraft wing.

As aircraft were improved, soaring became a sport, especially in Germany where powered planes were banned after World War I. Hitler made this a training program for the World War II air force that almost conquered the world. The U.S. Air Forces had troop carrying gliders used to capture Crete but gliders had limited value because they had to be towed. Commercial use was found impractical.

Sailplanes still are flown in contests. The Soaring Society holds meets at Harris Hill, near Elmira, New York. They are picked up by truck after they land. Gliders have played their part in air progress.

R - Encyclopedia Britannica under "Gliders".

PAPER GLIDERS

M - 2 different paper glider designs-- one is a control glider, the other is experimental, glider test/result ditto and/or log books, chart paper/magic marker.

S - Students construct both gliders.

S - Students test one variable at a time against their control glider. Students list the variables which might be tested.

A - * Cut the tail section, push it up and inside-out.
* Cut flaps in the wings.
* Bend flaps a lot or a little.
* Cut the wings into a different shape.
* Add paper clips for weight.

W - Students record the results of their tests.

R - Super Science Blue, Scholastic Inc. March 1991, ISSN 1040-144X.

LIFT

T - Before making and flying gliders, students should understand the principle of lift.

ACTIVITY #1:

M - Piece of paper, log book.

S - Students blow under a piece of paper and then over the piece of paper.

W - Record their results in log book.

A - Each time students blew, the paper rose up in the air.

ACTIVITY #2:

M - Two blown up balloons for each pair of students, log book.

S - Blow up two balloons. Blow between them, observe. Blow on the outside of both at the same time. Observe.

W - Write down observations.

A - When students blew between the two balloons, they came together. Faster air is creating less pressure between in the balloons and higher pressure pushing the balloon together on the outside of the balloons.

When students blew on the outside of the balloons, they moved apart from eachother. There was less pressure on the outside of the balloons because the air was moving faster and greater pressure between the balloons was forcing the balloons apart.

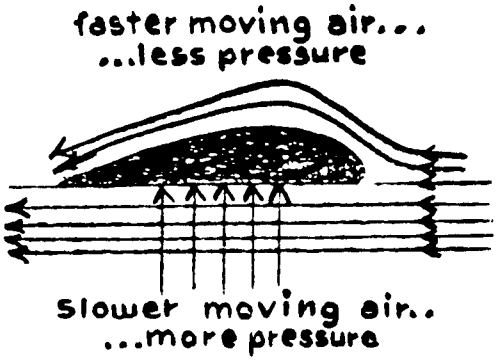
ACTIVITY #3:

M - Log book

TS - DRAW WHAT I DRAW. Teacher draws a wing shape on the blackboard or on chart paper. Describe the top of the wing as curved and the bottom as flat. As the plane flies, some of the air moves under the wing. Some goes over the top.

The air going over the top must travel farther and faster to reach the back edge at the same time as the slower air going underneath. This makes the air pressure going over the top of the wing lower than the air pressure going across the flat bottom.

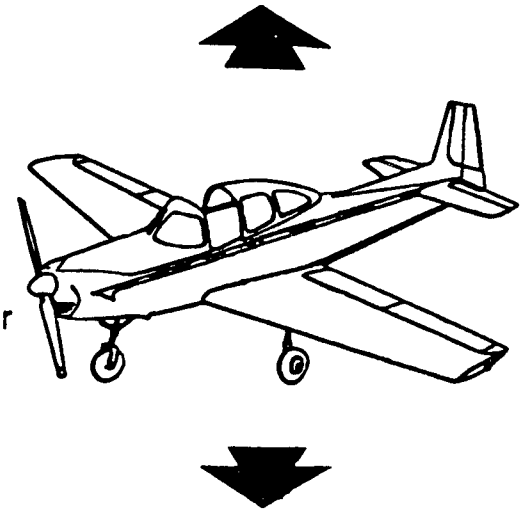
With less pressure above, and more pressure below, the plane gets the LIFT it needs.



WHY AIRCRAFT FLY

LIFT

Air flowing over the wings and the angle of the wing into the wind moves the aircraft upward.



THRUST

The engine turns the propeller. The propeller pulls the aircraft forward.

DRAG

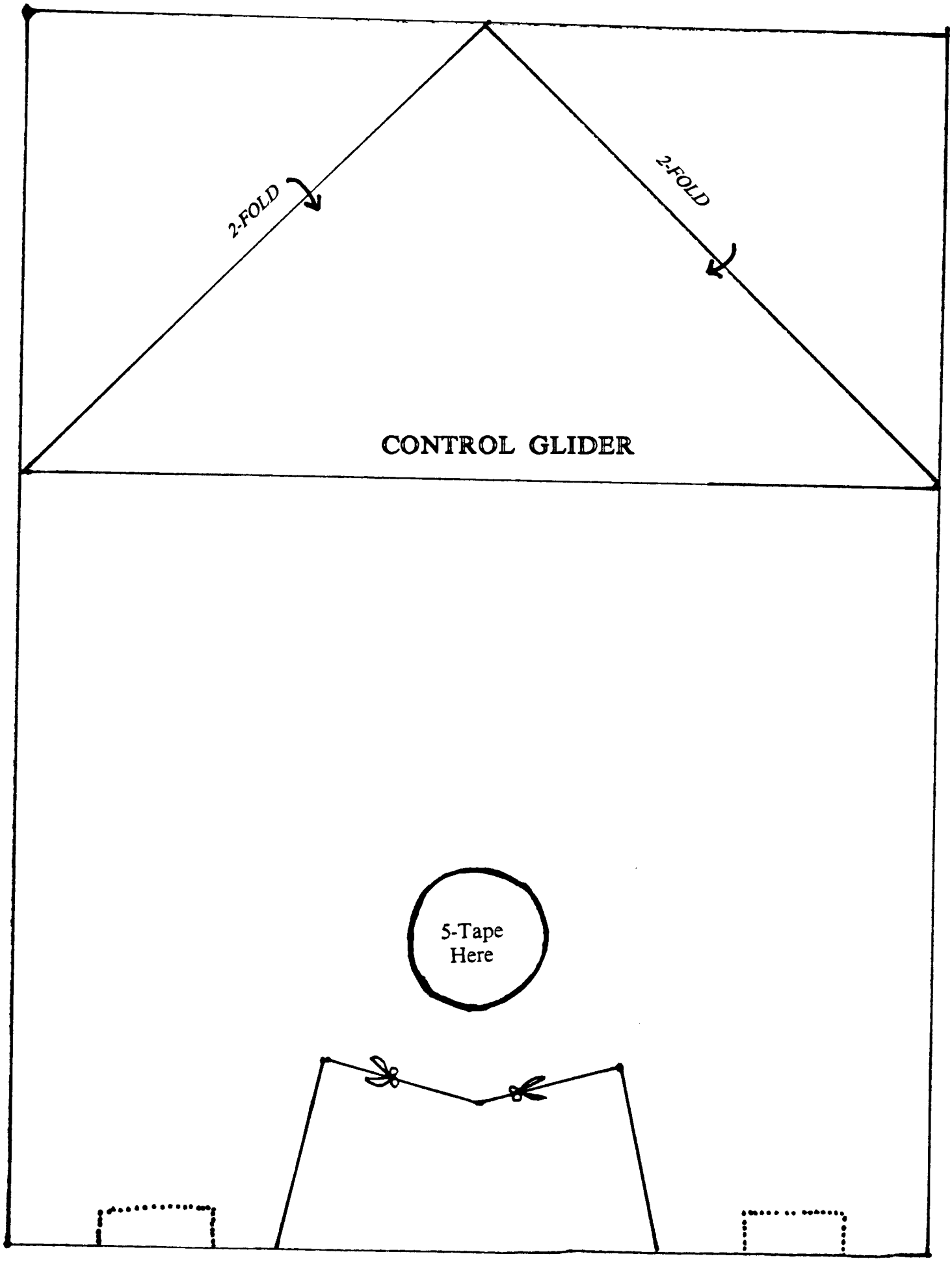
The shape of the aircraft slows its forward movement.

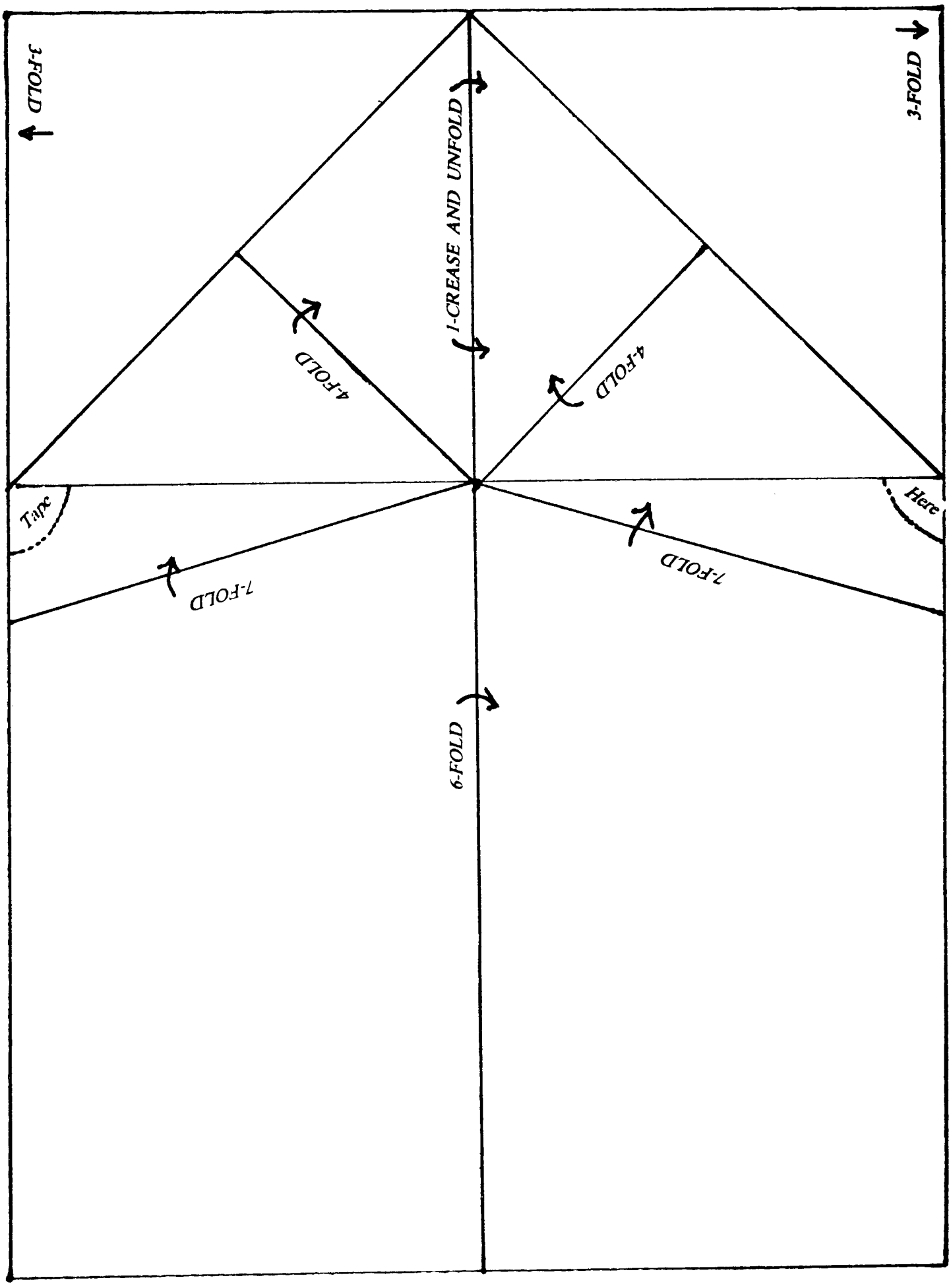
GRAVITY

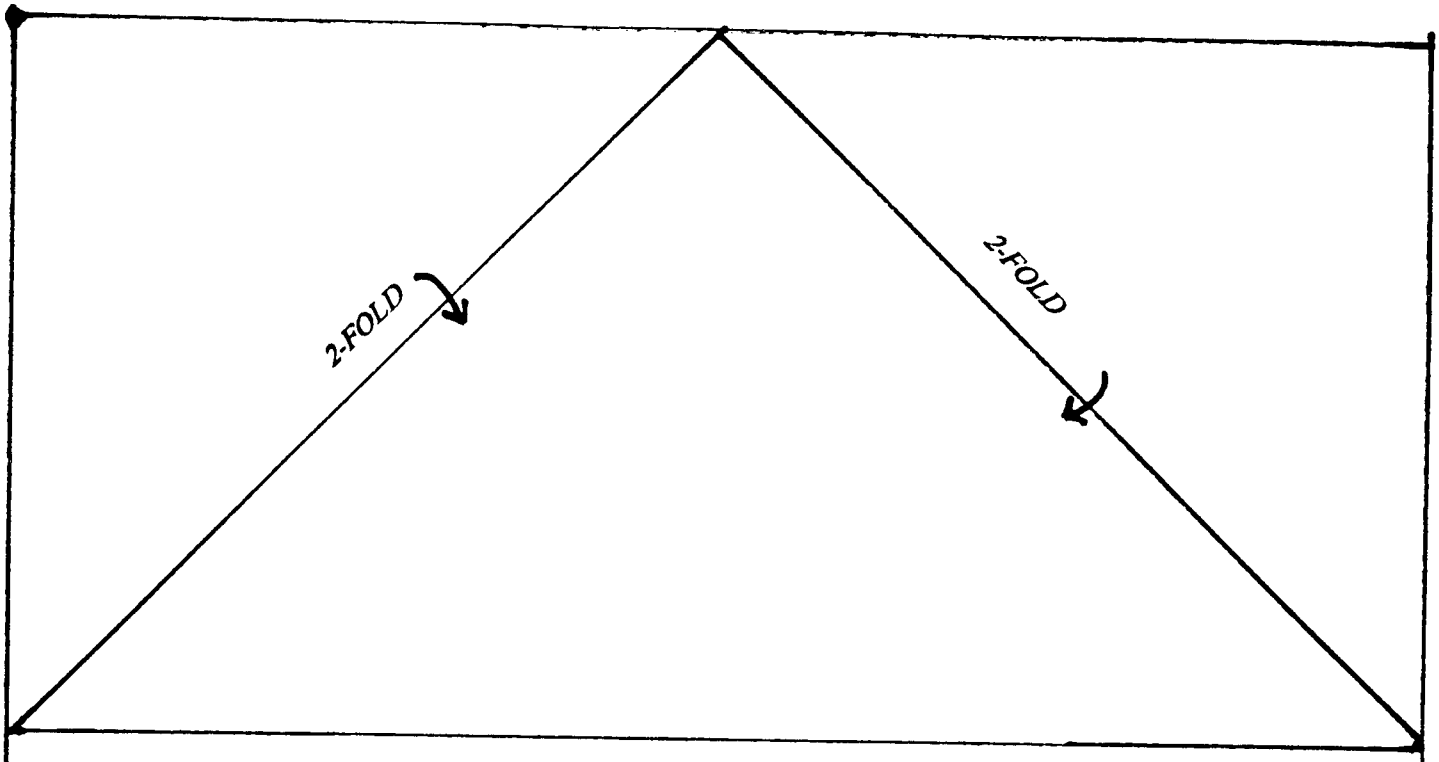
Weight holds the aircraft down.

To make an aircraft fly:

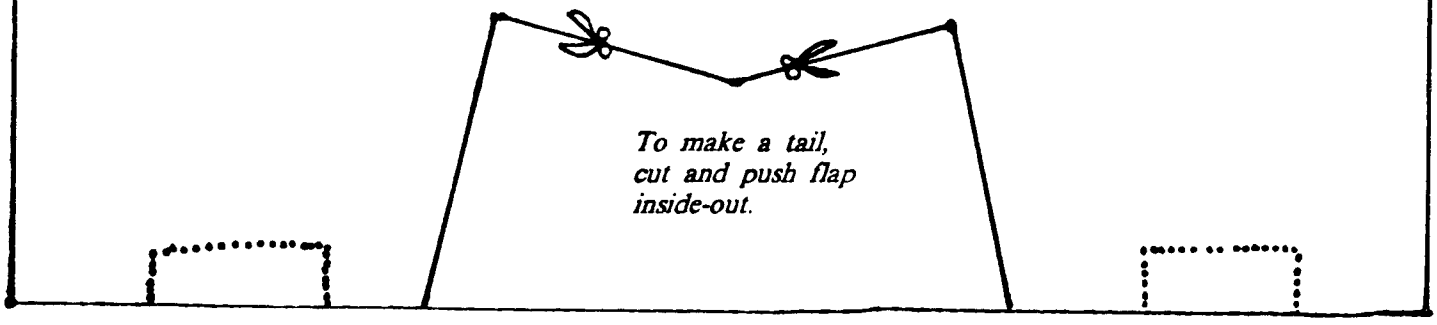
1. Lift must be greater than gravity (weight).
2. Thrust (power) must be greater than drag.

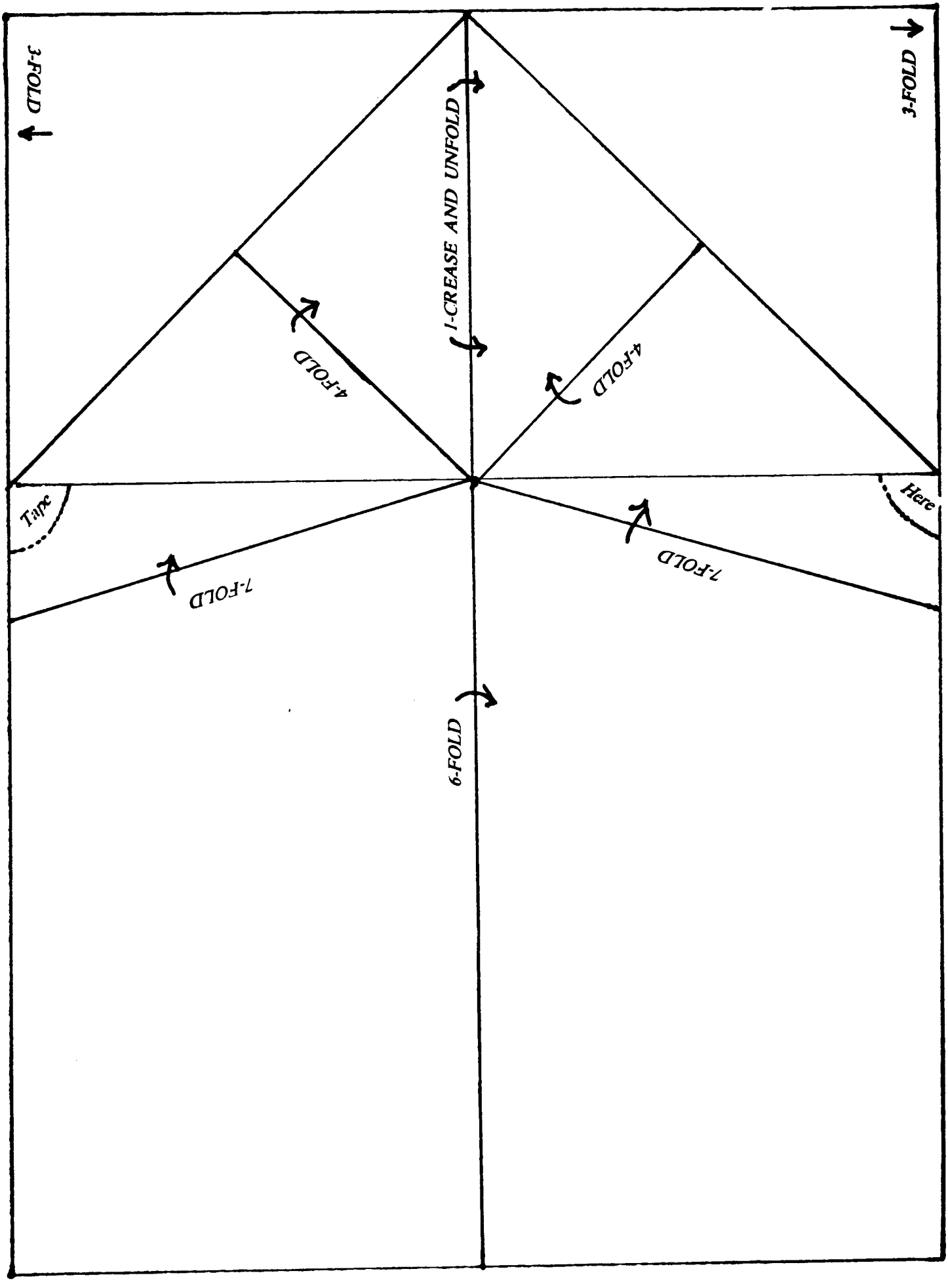

2-FOLD
2-FOLD
CONTROL GLIDER
5-Tape
Here


3-FOLD
1-CREASE AND UNFOLD
3-FOLD
4-FOLD
4-FOLD
Tape
Here
7-FOLD
7-FOLD
6-FOLD



EXPERIMENTAL GLIDER

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3-FOLD
1-CREASE AND UNFOLD
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Tape
Here
7-FOLD
7-FOLD
6-FOLD

Name _____

Period ___

Glider Tests

Control Flight

Describe how the control glider flies.

Design new tests and write down the results.

Test	Results
①	①

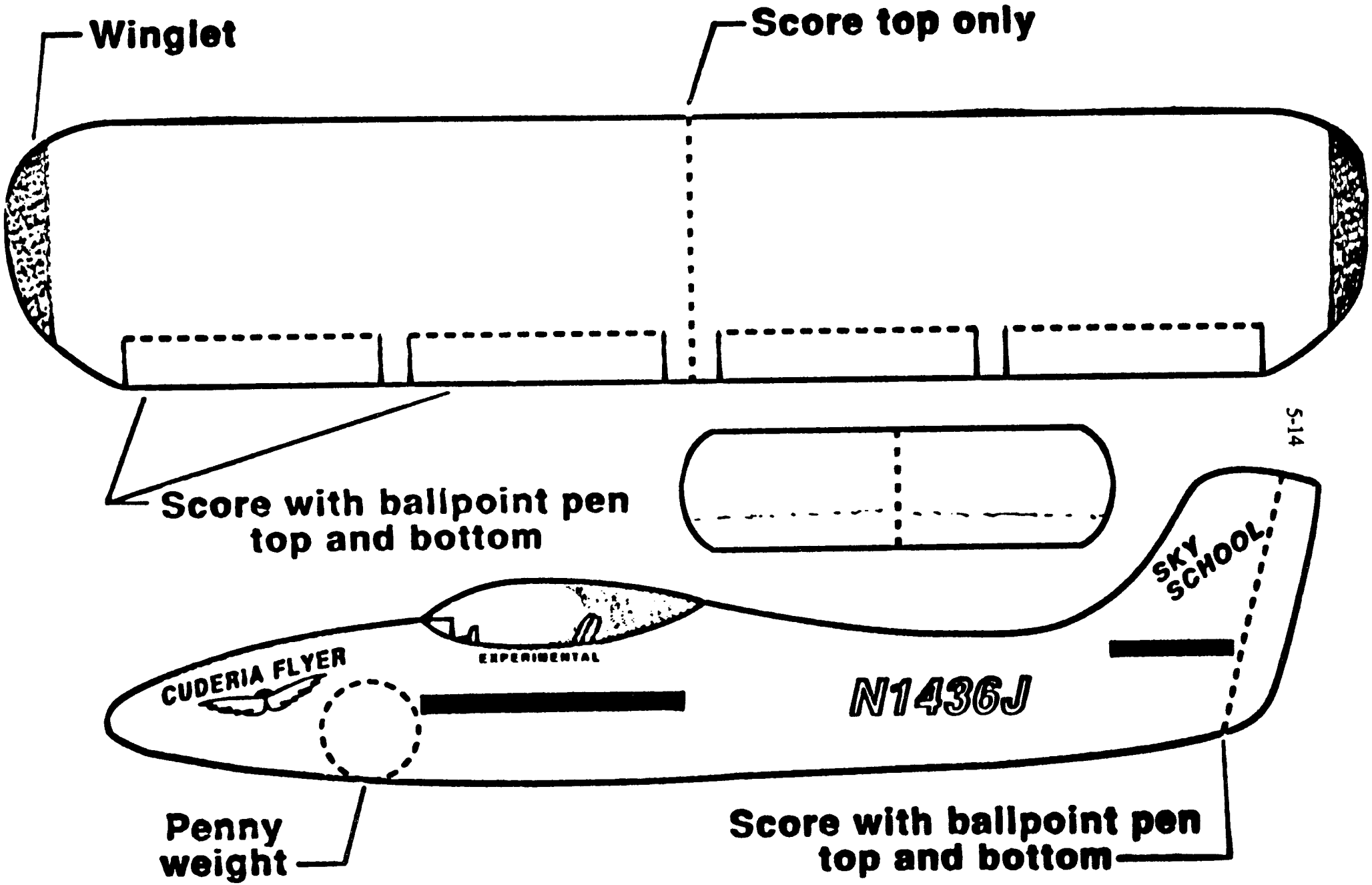
STYROFOAM GLIDERS

M - Styrofoam lunch tray, scissors, glue stick, glider design ditto, glider test ditto.

S - Students cut out parts of a glider and glue them onto the lunch tray. Cut out the glider and assemble it. Discuss the parts of the glider as compared to an actual plane.

S - Design tests similar to the paper glider. Conduct tests.

W - Record results of the test in log book or glider test ditto.



Designed by: Patterson Biggs

L E S S O N 6 -- P R O P E L L E R S

TS - History After gliders soared with lift by natural forces, propulsion was needed for aircraft to take off and keep flying by their own power. Propellers drive ships but engines and fuel are too heavy to fly until internal combustion engines were invented.

Dr. Samuel P. Langley, head of the Smithsonian Institution, designed an aircraft with a very light steam engine which flew but without a pilot.

Belief that flight was possible spurred invention. Success was won as in the case of balloons and gliders, by a third set of brothers. Orville and Wilbur Wright had a bicycle shop in the late 1800's. The brothers tinkered in their spare time and built a flying machine of fabric, sticks and wire and of course an engine. To fly, they went to the sandy seashore Kitty Hawk, North Carolina. The flight that was to change the world was on December 5, 1903.

Early aircraft were biplanes -- one wing above the other for double lift. Monoplanes -- one wing on each side like a bird -- were found better.

In early planes, inventors put the propeller in back to push the plane. Soon they realized it was better to place the propeller in front to pull the plane.

Large 4-engine flying boats were in trans-Atlantic service in the 1930's and 1940's. It was thought that in case of engine failure, they could float.

Smaller 2-engine flying boats were used in World War II. Single engine seaplanes fly from lakes and seacoasts. Amphibians fly also from land.

Large sleeper planes, like the railroad Pullman cars, made transcontinental flights in the 1950's.

Speed of prop planes is limited to about 300 miles an hour. To go faster, the tips of the propellers would have to go faster than the speed of sound.

Planes were made bigger by powering them with two engines, then with four. The biggest propeller plane was the six engine Air Force B-36 bomber, the "beast with six wings."

As planes flew farther, faster and higher, lift was increased by powering them with Jet engines.

Most propeller planes are powered by piston engines using gasoline, some by rotary turbine engines using kerosene jet fuel.

Most military planes, large transport planes and some business planes have jet engines.

Demonstration How a propeller works can be shown by an electric fan. The whirling blades slant to push against the air to go in one direction. If they slanted the other way, they would push in the opposite direction. Reversible pitch propellers reverse the thrust and add braking to shorten the landing roll.

A cardboard plane with a little propeller can be powered with a rubber band. Hobby shops sell materials and also have little gasoline engines. But these may cause accidents.

Model airplanes may be made of balsa, a light wood, and flown. This takes much time and results can be disappointing.

TS - Forces A kite is lifted by the wind. A motorless glider soars by the effect of sun heat. An airplane is powered by its engine only. All of them get their lift by their push against the air.

In flight, four forces are in balance -- thrust, drag, lift and weight (gravity). In an airplane, the thrust of the propeller driven by the engines, gives forward motion and also lift by pushing the wings against the air.

Drag is caused by the wings pushing against the air and by air resistance of other parts of the plane. Planes are streamlined as much as possible to ease passage through the air. The faster the speed, the more the lift and drag.

To climb, the engine speed is increased. Lift must exceed weight to make the plane rise. To fly level, the pilot sets a trim tab in the tail. To descend, the engine is slowed and the plane comes down like a glider.

STOL Airplanes Short Take Off and Landing can operate at low speeds; therefore can use short runways on small fields. They are slower and cost more than conventional planes for which airports are designed. STOL planes and airports are few.

Controls An airplane has an elevator on the tail to hinge up or down and a rudder to turn right or left as told in the lesson on gliders.

It has ailerons -- flaps on each wing to slant up or down in opposite directions and tilt the plane sideways. They are used for turning so the plane changes direction smoothly. And they are used for side slipping to descend for landing. Ailerons are worked by tilting the control stick sidewise or by turning a wheel at the top of the stick. A plane's wings are slanted slightly upward to keep them in balance.

Instruments Several instruments are necessary for navigation and safety. The compass shows direction of flight; the altimeter shows altitude above sea level. A dial shows air speed. Another shows how fast the propeller is turning in revolutions per minute (RPM). Gauges showing engine temperature, fuel and oil supply are similar to those in autos.

Large planes have dozens of dials for the pilot and copilot to watch. But if you learn to fly a light plane, those names can get you across the country.

R - Encyclopedia Britannica has details under "Aeronautics." Interesting material on military and civilian aviation is abundant. Too much time should not be spent on obsolete planes.

PARTS OF A PLANE

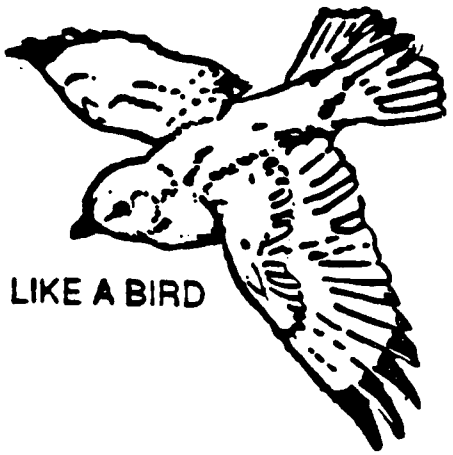
M - Airplane design ditto, Mini Page 1990 -- The Parts of a Plane, Student Handouts # 1 and # 2 -- Airplane parts.

TS - Compare parts of a bird to the parts of a plane, then compare parts of a fish to the parts of a plane.

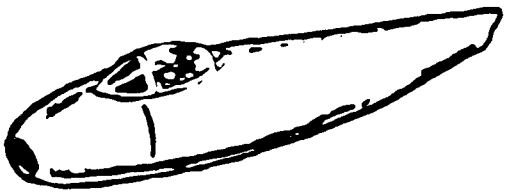
S - Students design a plane by putting the bird and fish parts together. Student Handout #1.

TS / S - Read over The Mini Page 1990 -- The Parts of a Plane. Parts of a plane are noted as well as the function of each plane part. Complete activities.

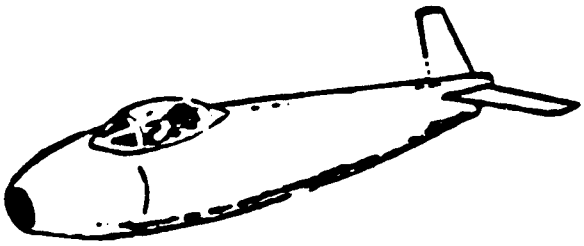
TS - Study the Student Handout # 2 -- Airplane parts. Complete Student Handout #3 on airplane parts.



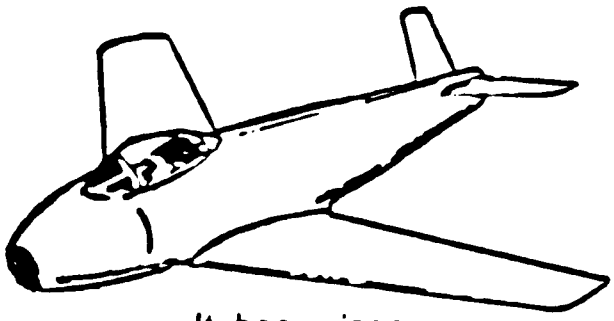
AN AIRPLANE IS LIKE A BIRD



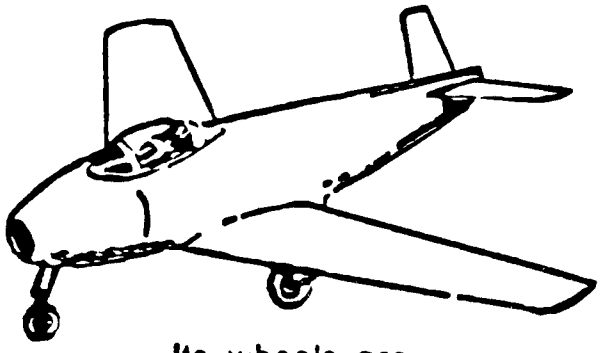
It has a body



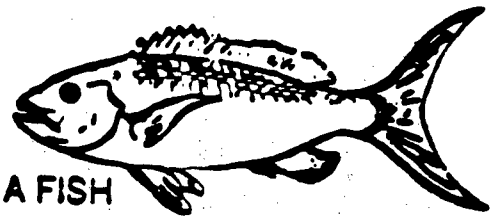
It has a flat tail.



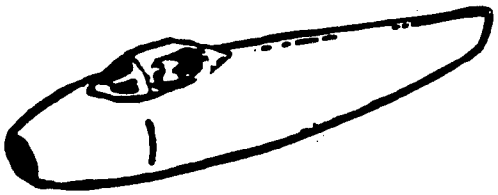
It has wings.



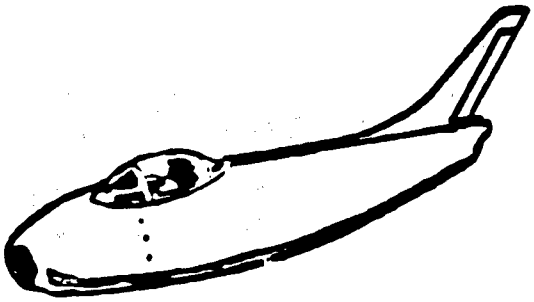
Its wheels are like feet.



AN AIRPLANE IS LIKE A FISH



It has a body.



It has a tail called a rudder.

Directions: Draw an airplane by putting the bird and fish parts together.

Especially for kids and their families

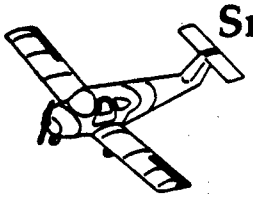
The Mini Page

By BETTY DEBNAM

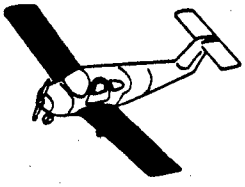
Let's Learn About Flying

The Parts of a Plane

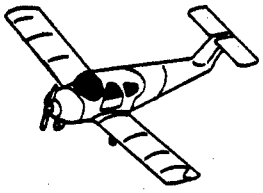
Small Planes



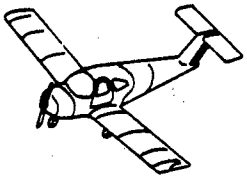
Ailerons: (ail-e-rons): movable edges of a wing that move in opposite directions (one up and one down). They make the plane turn.



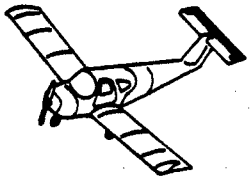
Wing: parts that give lift and support the weight of the plane while it is in flight.



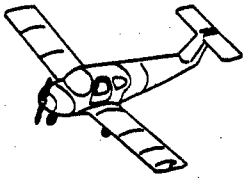
Cockpit: the control center where the pilot sits.



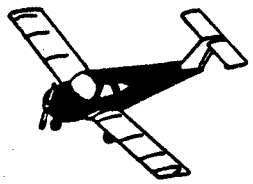
Rudder: the vertical tail part that moves left or right and helps the plane keep steady.



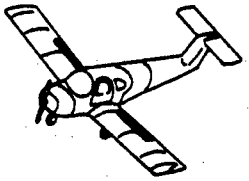
Elevator: movable horizontal part making the plane move up or down.



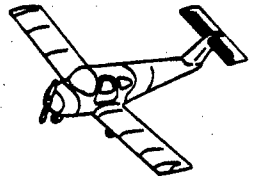
Propeller: a twisted turning blade that usually pulls the plane through the air.



Fuselage: body of the plane for the crew, passengers and cargo.



Flaps: can move only down. When they're down on landing, they act as air brakes. When down on takeoff, they increase the "lift."

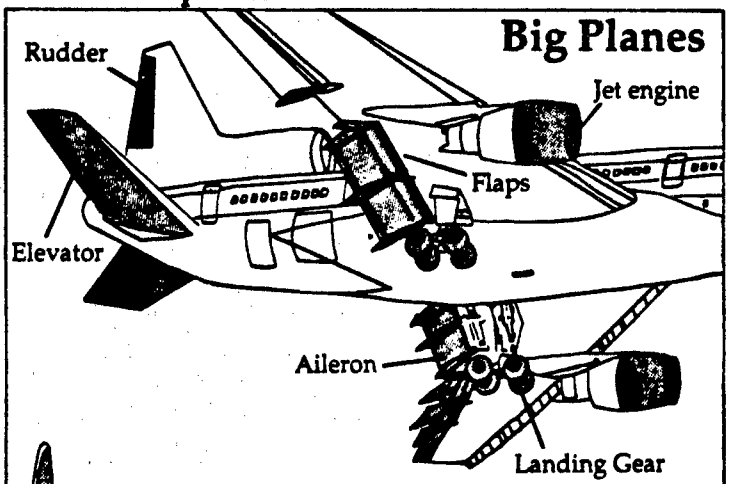


Horizontal stabilizer: used to balance the plane.

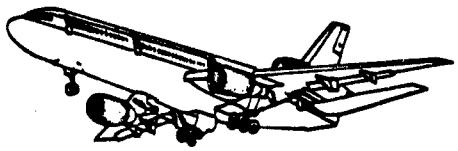
Landing gear: the wheels or floats (on sea planes).

Are you taking a flight soon? It's fun to learn more about planes.

Big Planes



Propellers pull airplanes through the air. But not all planes have propellers.

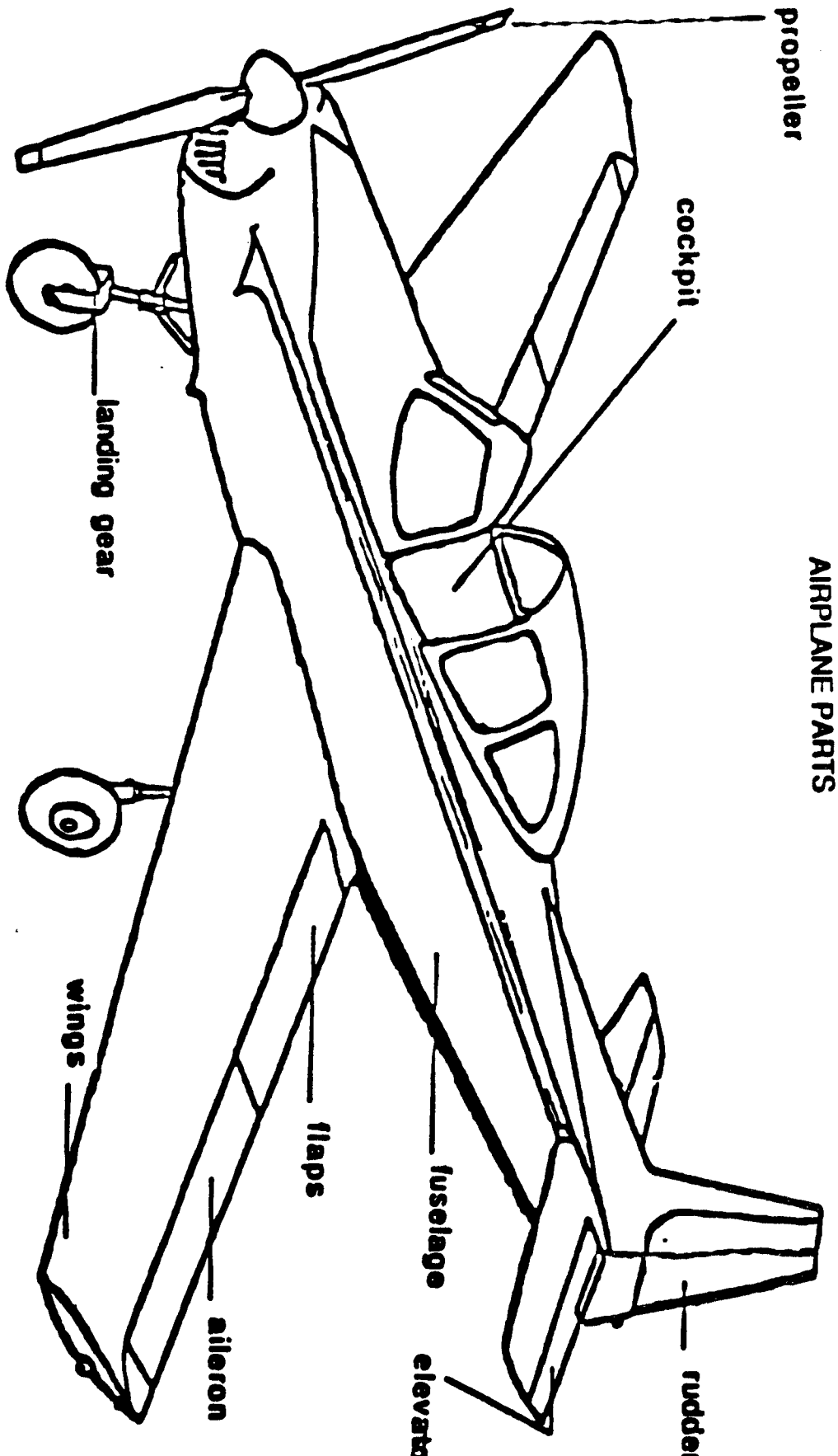


Jets have engines that push them through the air.

Horizontal (hor-uh-ZON-tal) means across, from left to right.

Vertical (VER-tuh-kull) means from top to bottom, upright.

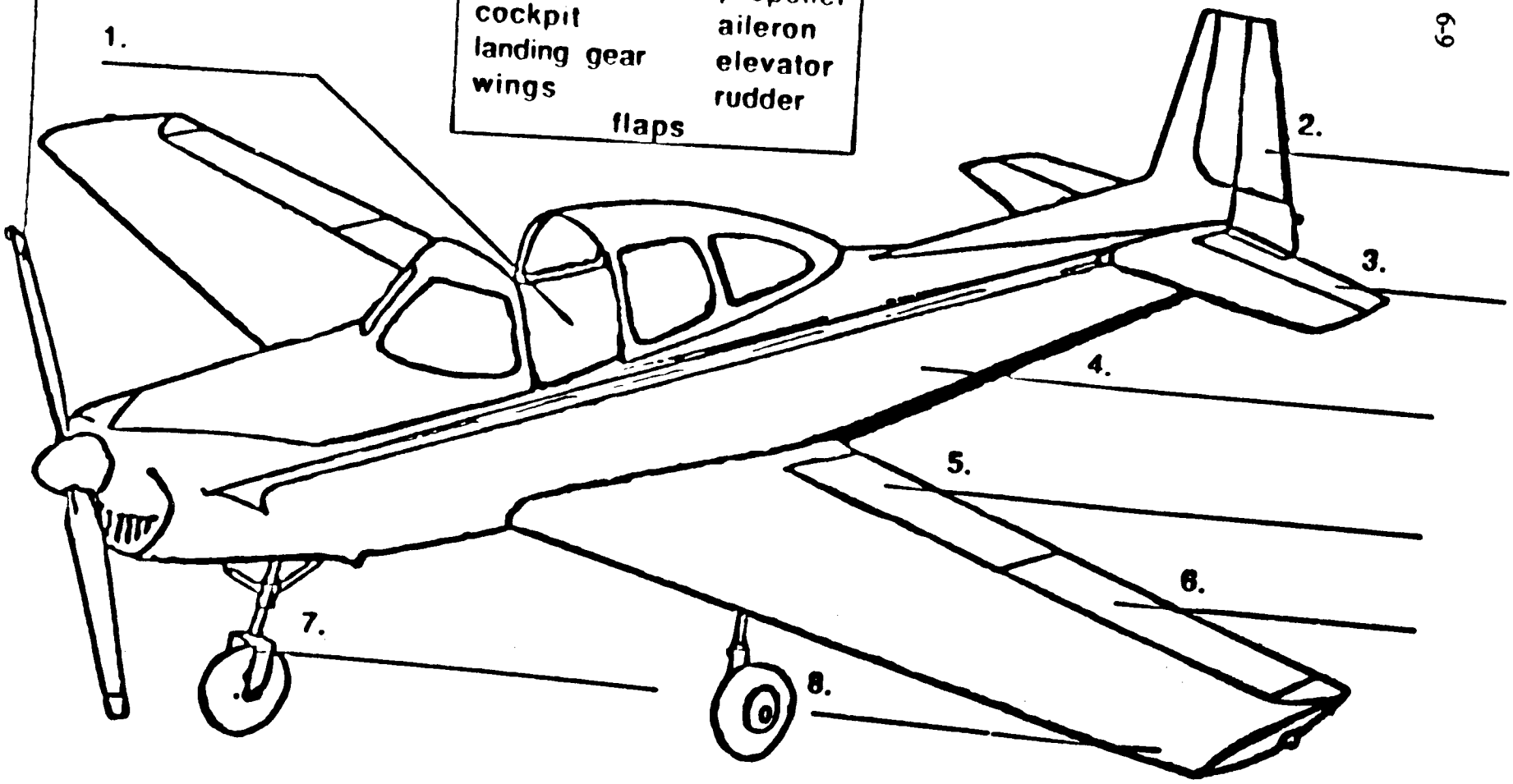
The Mini Page thanks the Federal Aviation Association for help with this issue.


AIRPLANE PARTS
propeller
cockpit
landing gear
wings
flaps
fuselage
aileron
elevator
rudder

Directions: Discuss words in the word box. Label each part.

WORD BOX

fuselage	propeller
cockpit	aileron
landing gear	elevator
wings	rudder
flaps	



Blimp

LESSON 7 - LIGHTER-THAN-AIR

TS - Before large airplanes were feasible, powered balloons were the only way for air travel. Gas bags floating on air gave the lift. Power was needed only for thrust.

Alberto Santos-Dumont, a Brazilian in Paris, France, flew powered balloons at the turn of the century. He is said to have been on the way to inventing an airplane.

Powered balloons, called blimps, still are used for advertising. The Goodyear blimp is a familiar sight and is approximately 200 feet long and can carry up to 10 people.

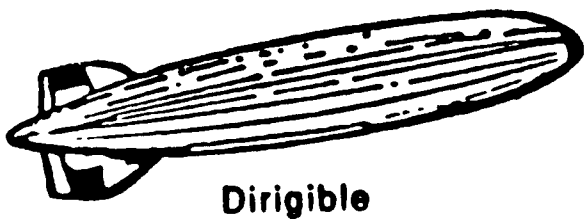
Much larger craft called dirigibles were built on metal frames--principal inventor was a German, Count Ferdinand von Zeppelin. The name comes from the latin *dirigere* meaning *to direct or steer.* This dirigible was used in World War I to bomb London. This did not reduce British capacity to fight.

Progress was fast in the 1920's. The U.S. Naval Air Station at Lake Hurst, New Jersey, was a base for takeoffs and landings. Airships were in demand for air shows. One named the Shenandoah flew into a thunderstorm and broke in two. The crew brought part of the ship to a landing. Rosenthal, later an Admiral, was in command.

Helium Discovered - A hazard in balloons was the gas that carried them aloft. The gas was flammable. Hydrogen and other lighter-than-air gases, when combined with oxygen in the air burned with explosive force if ignited.

A light gas that would not burn was discovered after the invention of the spectroscope. This device showed each chemical element and a pattern of colored lights. The unknown gas was found in the sun. It was called helium. Helium was found in Texas natural gas.

Trans Atlantic - Meanwhile Germans began regular service for passengers and mail from Germany to New York via Lake Hurst. For flying at some 69 miles an hour, they crossed in half the time of steamships.



Dirigible

But the U.S. Secretary of Interior hated the Nazis and would not let them have helium. So a splendid airship, the Hindenberg, when attached to the mooring mast for a landing, burst into flames.

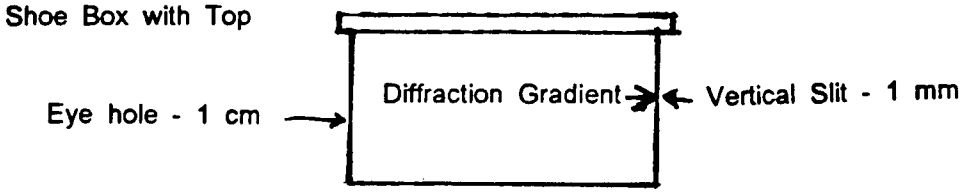
That ended airship travel. For a few more years, there was still hope of finding uses, but as airplanes became bigger and faster, there was no further use.

R - Encyclopedia Britannica under the heading of Dirigible

Activity One:

Spectroscope

M - shoe box with top, diffraction gradient, scissors



S - Students build a spectroscope using a diffraction gradient. They are to observer the variety of light patterns in parking lots during evening hours. (Important: Parents should accompany students when doing this activity.)

TS - The spectrum from white light emits atoms of red, orange, yellow, green, blue indigo and violet. (ROY G. BIV) When students observe the vibrating action of the molecules in parking lot lights, they will notice a variety of spectrums.

S - Students should examine the class lights and sun.
W - Record spectrum and then color the spectrum observed. Now go to parking lots and compare and record new spectrums.

Activity Two:

S - Blimp Photo Album--If you see the Good Year Blimp, take a photograph and place it in the class photo album.

W - Label the location and date observed. State its location if known.

LESSON 8 - ROTOCRAFT

TS - An airplane gains forward motion from the thrust of its propeller and lifts by tilting against the air.

A helicopter gains lift from the upward thrust of its rotor and horizontal motion by tilting.

S - Discuss to be sure this is understood. Refer to Lesson 5 on thrust and lift.

TS - A helicopter can move up, down, forward, back, right, or left. It can hover like a humming bird. In addition to the lift rotor, a tail rotor like a propeller keeps the craft from turning round and round. Or two lift rotors turn in opposite directions.

History - Leonardo de Vinci, an inventor as well as a great artist, foresaw what vertical lift could do. He sketched a helicopter-like device centuries before there was an engine to fly it. Igor Sikorsky built the first helicopter. It could lift its own weight.

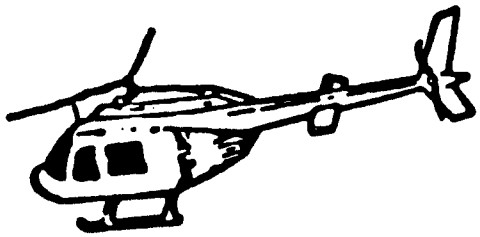
Helicopters did not come into use until the 1940's. Light planes had served well for a variety of civilian and quasi-military uses in the Civil Air Patrol of World War II though not for combat missions. They could have flown. The need was seen for aircraft that could land and take off on the battlefield. The first few helicopters were flying at the war's end.

It was decided to call the new aircraft "hell-copters" rather than "hell-icopters." Sikorsky called them "halicopters."

In the Korean War short-landing light planes were used. In Viet Nam, helicopter gun ships attacked ground forces.

Q - What uses of helicopters can you think of?

TS - Civilian uses continue to increase, including auto traffic control and law enforcement. Many lives have been saved by flying patients to helipads at hospitals. The President of the U.S. flies a helicopter from the White House to Camp David, Maryland for meetings. In Japan, many islands near the coast are reached by helicopter.



Helicopter

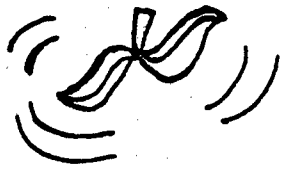
Helicopters fly some 120 miles an hour and are limited in range.

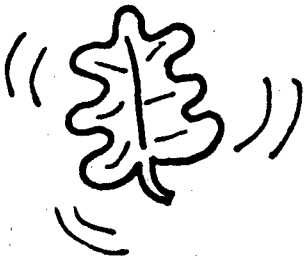
Tilt Rotor - The Marine Corps Osprey V-22 is a VTOL aircraft--Vertical takeoff and landing--that flies like an airplane, 300 miles an hour. If a civilian version can be developed, it can fly directly between city centers without airports.

R - Encyclopedia Britannica under the heading of Helicopter.

Activity One:

S - Observe natures own helicopters--leaves. Gather an assortment of leaves and seeds. Drop them and record their movements.





Activity Two:

Demonstrate the pull of a propeller.

T - Obtain a rubber band powered model glider or plane.

S - Wind the propeller. Let it go. Observe the pulling motion of the propeller as it relates to the props of a helicopter.

S - Now rewind the prop in the opposite direction.

W - Do you observe a different motion? Explain.

L E S S O N 9 - J E T S

T - Modern flight is too complex to understand fully without years of study. Not much can be learned from classroom demonstrations aside from videos. The lessons for jets and rockets outline is progress of invention without too many details. By discussion and research, eager young students can get a clear idea of how the problems were solved.

History - TS - After propeller-driven aircraft were improved as much as they could be, a faster means of propulsion was needed for further progress. Planes had been made faster and larger. They could fly thousands of miles without landing to refuel. But planes could not go more than 300 miles an hour for the propeller tips would not exceed the speed of sound.

The high thin air aloft has to be compressed for passengers to breath and the engines to ignite. Even so, planes could not cruise at much over 10,000 feet. After Charles Lindberg's solo flight to France amazed the world in 1927, Atlantic crossings became common place. Amelia Earhart was the first women to cross the Atlantic from Newfoundland to Wales in 1928.

The U.S. and allies in World War II held superiority in air power, but Germany had technology. When an American pilot saw an enemy plane without a propeller, he was not believed. Had the Germans made the most of their invention instead of bombing London, it would have been harder for us to win.

Transition - In transition, JATO pods (Jet Assisted Take Offs) were put on propeller planes to give planes an extra boost in take off. The Air Force B-36 Bomber had ram-jets for burst of speed. The Navy had a fighter weith both prop and jet.

Soon after the war, the Air Force had jet fighters flying and was designing bombers. The Boeing 707 was the first of a series of jet airliners that would lead the market though foreign nations were gaining. The commuter airline fleet is still propeller driven including turbo props, mostly of foreign make. Small jet planes are used for business travel.

How It Works - A jet engine is a turbine attached to a compressor that blows air behind it to drive it forward. This is further explained in Lesson 10.

Jet engines are powered by kerosine jet fuel rather than by gasoline. So are turbo props. Frank Whittle of Coventry, England was a leading pioneer in the development of jet-propelled commercial aircraft.

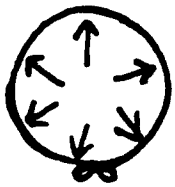
Supersonic jet airliners fly at nearly 600 miles per hour close to the speed of sound, fast as a pistol bullet. A supersonic plane makes a noise like a thunderclap which breaks windows if the flight is too low. After experiments with the X-I, Air Force jets were designed supersonic. The U.S. failed to develop a supersonc airliner. The British and French teamed upto develop the trans-Atlantic Concord.

Activity One:

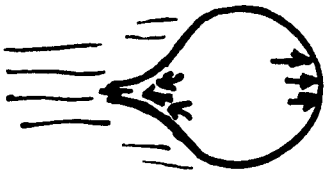
DRAW WHAT I DRAW:

S - Blow up a balloon and let it go.

T - Draw a blown up balloon. Place the arrows representing even air pressure all around the balloon.



T - Now draw a second balloon. Let the arrows of air pressure represent that air comes out of the small hole, but the balloon is thrust forward.



Activity Two:

Stamp Collection

S - Make a class stamp collection of airmail and air plane stamps. (Either an original or picture can be placed in the collection.)

S - Students can design an original airmail stamp of their own.

LESSON 10 - ROCKETS

How They Fly - T- To demonstrate rocket flight, inflate a toy rubber balloon and let it fly. It flies until it is deflated. (Review Activity One - Jets.)

TS - Discuss. Let students see that the balloon seems to fly by escapintg air pushing against the air outside. But if we were to believe everything as it seems we still would think the world was flat.

As an approach to the truth, bring out that rockets fly out in space where there is no air to push against.

TS - The fact is that the little balloon flew as jets and spaceships do because the pressure inside is more than that outside. Where the air flows out, the pressure is reduced to that outside. So the pressure inside forces movement in the other direction. That is how jets and rockets fly.

Fuel - Unlike jets and piston engines, rockets do not use oxygen from the air. They must carry all the ingredients for combustion that powers the flight. Small rockets use solid fuel and large ones liquid fuel including liquid oxygen.

History - The Chinese invented gunpowder used for rocketry.
For more than two centuries, small rockets have been used for military and naval signals by colored flares.

The British used rockets to carry explosives. They were not very accurate. Our national anthem tells, "The rockets red glare, the bombs bursting in air, gave proof through the night that our flag was still there."

Dr. Robert Hutchings Goddard constructed and shot the first liquid fuel rocket. Goddard has a NASA center named after him, Goddard Space Flight Center, in Greenbelt, Maryland.

In World War II, the Germans made rocketry a science. To bomb London, they first used pilotless planes powered by pulsejet engines, then rocket missles. They destroyed few military targets.

Werner von Braun headed the program. After the war, he came to America with some of his team to work for the U.S. Army. Others went to Russia. Rival programs began.

Rocket Race - Both nations wanted to design a missle that could carry a nuclear bomb and to fly into space. Problems were great. To fly free from gravity, rockets need an escape velocity of about 2,200 miles per hour (mach 3 1/2, mach 1=630 mph). To re-enter the atmosphere, it has to be slowed not to be burned by friction like a shooting star.

The U.S. had no great sense of urgency. In 1957, a rocket was being readied to orbit the earth. Volunteers were to trace its course with little telescopes. Then came the shocking news that Russian Sputnik had done it first.

Aerospace fast became a leading industry. A great variety of missiles were produced. The aim was to make so many inter-contintal missles that the Russians would not dare to attack us. The war with Iran proved their deadly force in 1992. Only now after 40 years, the collapse of the Soviet Union makes it possible to reduce the great expense.

Many billions a year have been spent uselessly for contracts and subcontracts. Factories and military bases have been built especially in areas represented by ranking members of Congress. Thousands of missiles are ready in silos and in nuclear submarines to blast enemy targets. It is hoped that much of this can be dismantled as war becomes less of a threat.

Mercury flights were the first manned series which were suborbital. The first man to complete the suborbital flight called the "Freedom Flight" was Alan B. Shepard, Jr. The flight on May 5, 1961, lasted 15 minutes and 22 seconds.

The first man-on the moon was Neil Armstrong from Apollo 11 on July 20, 1969. His famous statment was, "One small step for man, one giant leap for mankind."

A space shuttle can carry several people into orbit for a few days and land like an airplane. Removed from the pull of gravity, experiments can be made under weightless conditions. Men in space suits repair satellites. One shuttle flight, Challenger, exploded but the work was resumed.

Unmanned space vehicles send photos of the sun's planets and revealed much that was unknown. Satellites that remain in orbit, relay television and communication signals. They bring weather information and the whole world to view from the sky.

Future - A visit to planet Mars and a manned space station may be delayed for lack of funds but are feasible. The Hubble telescope now in orbit can get us looking further into space and yet find no end to it. What wonders are yet ahead?

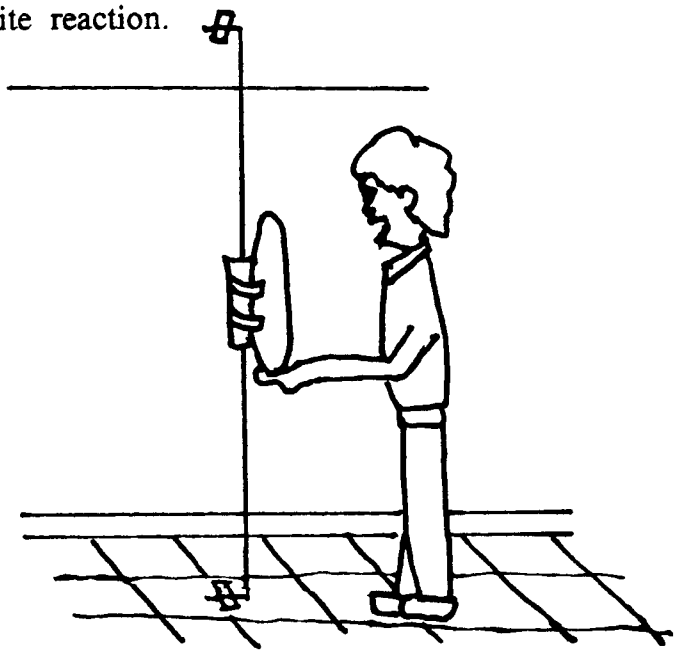
The growing belief is that unidentified flying objects that seem to move at tremendous speed are piloted by beings from other worlds, with technology superior to ours. We may attain that technology later. This is a time to keep open and inquiring minds.

Activity One:

Rocket's Thrust

M - string, tape, balloon, straw

S - Tape an inflated balloon to a straw. Thread straw through the string. Attach string to floor and ceiling. Release balloon neck. Observe and record movement. Relate to Isaac Newton's Law of Motion -- For every action there is an equal and opposite reaction.



Activity Two:

TS - Visit the National Air and Space Museum in Washington, D.C. to observe the history of flight.

T - Prior to visit, schedule docents to guide your students.

Activity Three:

T - Divide class into groups of four (vary ability levels).

TS - Students are to design and test a rocket of their creation which can carry a payload of 4 paper clips attached to the rocket. The purpose is to demonstrate the rockets ability to fly farther than other groups' rockets. They are to record and analyze data and prepare a report of their success.

R E V I E W

Aviation Introductory Lessons 1-10

(Print on one side of single page.)

Name_____ **Date**_____

1. Do you think you might want a career in aviation?

   ___YES ___NO

2. If yes, what branch of aviation would you prefer?
   (Check One)
   ___Military ___Airline ___Business flying
   ___Air traffic control ___Rotocraft
   ___Airport Management ___Other

3. Would you like to learn to fly? ___Yes ___No

4. How do you rate the lessons so far?
   ___Excellent ___Good
   ___Fair ___Poor

5. How can the lessons be improved?

6. Do you want further aviation lessons? ___Yes ___No
   Subjects can include weather science, navigation and engines. What else would you like to know about?

7. On the back page, write an essay on what you have learned from the lessons.

AIRPORT VISITS

T - SEEING AIRPLANES can be exciting, better understood after learning from Lesson 6 how they fly. For a close look, a small field used for private flying is better than a busy terminal. Aviation is a local industry, open to all.

The airport manager has reason to welcome kids. They maybe future flyers and airport boosters. For lasting friendship, between airport and schools, student discipline must be strict.

A good way is to divide the class into groups. Name a leader to keep each group together and well behaved, an important job. Color-code leaders by arm bands -- red, yellow, blue, green.

Keep far from whirling propellers. They must not touch anything, especially plane wings, which can be easily damaged.

Airport people can explain equipment and activities. They can ask questions so students think as well as look and listen.

Controls - A pilot pulls the control stick. The flap in the tail hinges upward. Q - How would that affect flight? A - The rushing air pushes the plane's tail downward. The nose turns upward. Same question for rudders and ailerons. Put each student briefly in the pilot seat to get the feel of the controls.

Instruments - Show and tell. Altimeter was set to air pressure. Why? A - Air pressure varies, if it was set to one pressure it would be wrong. It changes.

Maintenance - Safety Keeping planes flyable. Parachute packing.

Fly - Pilot makes pre-flight inspection for safety. Wind sock or tetrahedron shows wind direction. Q - Which way does the plane fly? A - Against the wind. Q - Why? A - Airspeed. Note how the plane speeds on the runway for lift. You learned that in kites.

A homemade plane can be shown and flown by a member of the Experimental Aircraft Association. Assembling one can be a high school project.

Each student group will watch airport events separately and change to another when a whistle is blown. Blow double blasts to assemble for the fly-by/tripple for departure. Group leader calls the roll. Keep team together. If all goes well, future visits will be welcome.

In transit - presumably by chartered bus, keep students alert. Note points of interest and route numbers, street names, businesses, etc., so they can find their way again.

Airplane rides on school visits might bring costly liability suits, in case of an accident and should be handled by the airport operator with consent of parents.

S - Complete question sheet while at the airport. See sample questions which were composed during a teacher pre-class visit.

E - Write an essay on what was seen and learned.

AIRLIFT FOR YOUNG MINDS

NAME_____

GROUP_____

BUS_____

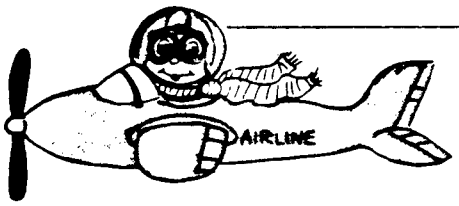
CHAPERONE NAME_____

Travel Questions

1. What route numbers did the bus travel on?_____

   _____

2. Name 5 businesses passed on the road. (Hint: Look for initials.)



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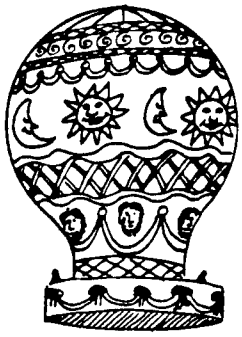


At the Airport

1. How much do helicopter rides cost?_____
2. What is the name of the company which gives helicopter rides?_____
3. Describe what you see on the T-33 Jet.

   _____

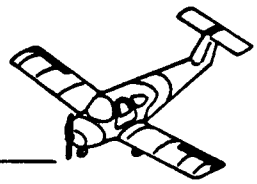
   _____

   _____

4. What two types of fuel are found on the FUEL FARM?

   _____

   _____



5. Name the two types of fuel trucks.

_____

_____

6. Why do people place their planes in Hanger A?

_____

_____

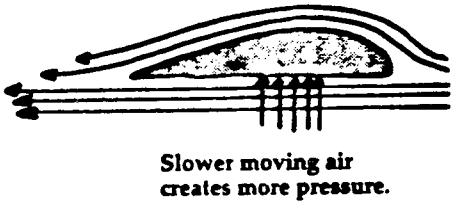
_____

7. Why do some planes have 2 steering wheels? What do you call the 2 wheels?

_____

_____

_____



8. How do the planes get moved around?

_____

_____

9. How many planes are kept on the Air Park grounds?

_____

10. How does a plane get refueled?_____

_____

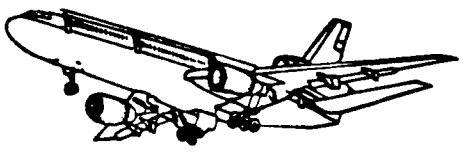
11. Why do planes have to keep gas in their wings?

_____

_____

12. What radio frequency does the Air Park operate on?

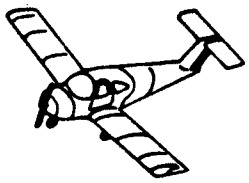
_____



13. What two compass dials are the landing strip on?

    Draw the Compass landing runway.

    _____



14. Which direction does a plane take off?

    _____

15. If a plane can't land at the Air Park, where can it land?_____

16. Name at least three different buildings at the Air Park.

    _____

    _____

    _____

17. What two things does the radio communicator tell the approaching airplane?

    _____

    _____

18. Name 5 careers at the airport. Describe their jobs.

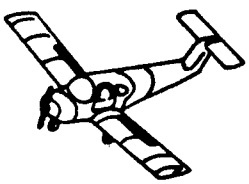
    _____

    _____

    _____

    _____

    _____



Drawing of an Airplane

Label the parts.

CAREER GUIDANCE

T - EDUCATION has been used to bring more new workers into aviation than are needed. But the same knowledge is useful in all modern industries. With this broadened purpose, aviation education can be of far greater benefit to the oncoming generation.

Young people excited by aviation are likely to think of it as their future vocation. This is possible but may be difficult. Students should be told the facts and advised where jobs are most likely to be found.

Due to recession and changing times, thousands have lost their jobs with little early prospect of rehiring. The airlines are gaining traffic but economizing in personal. Budgets for military forces have been cut as the threat of a big war is reduced.

On the plus side, replacement jobs open as employees retire, quit or die. Air traffic control and military pilot trainees are recruited. Corporate and helicopter flight are increasing.

Aerospace and space employment are hard hit with thousands laid off and thousands more to go. Education continues as if many new workers were needed. Youngsters still are led to play astronauts though barely dozens will go into space in the present century.

Pretending to be aviators can become real. This can open the way for youngsters to learn to fly at thousands of small airports across the country.

A boy or girl can get a student licence at age 18 and fly solo after a few hours of duel instruction. With a private licence, a pilot can carry passengers not for hire; with a commercial licence can fly for hire; and with an air transport licence can fly airliners. A pilot can fly for recreation and personal travel.

Learning To Fly Where schools teach about aviation from an early age, many students will want to fly. Flight scholarships can reward excellence in studies. It does not cost much to bring a student to solo. Local funds can be raised as for other good causes.

Student pilot applications have declined sharply. Thousands of small airfields are supported largely by local flying. New pilots are needed to keep flight operators in business and fields open. Form an action group by the Illinois plan. See page 1.

The eager interest of each generation has kept America first in the air. Teachers who keep this spirit alive will be doing a great service to our country.

FURTHER LESSONS

ORGANIZED LOCAL ACTION NATIONWIDE requires a uniform plan that works anywhere. Our 10 introductory lessons can be applied not only in scattered classrooms, but in entire school systems. They can be taught at all grades above the second in one semester or spread through a school year.

The pages can be separated and punched for a loose leaf binder where added information and research references can be inserted for each lesson.

Lessons so far arouse student enthusiasm and keen interest among adults. For the next semester or school year, practical subjects as well as history and theory can include navigation, weather, engines, airports and fitness for flight.

A full program should escalate year by year from pre-school through high school. Meanwhile the lessons can be improved by the experience of participating schools. We need to know about successful plans and further ideas. Also we need summaries of the answers to questions in the student exam after the first ten lessons. What students think is most important.

Please send to Susanne Paper, 12001 Ambleside Drive, Potomac, Maryland 20854.

We are not yet equiped to answer inquiries or engage in correspondence. We hope the way to share information between schools soon can be found.

Action is urgent. In world markets, more Americans must be trained to compete with the growing skills of foreign workforces. In our cities, lack of training causes unemployment, poverty and unrest. Other plans would change the present system at great cost by the year 2000. This plan improves the system at no cost starting now.

We hope this can help begin to reverse the decline in U.S. education.

KENDALL K. HOYT and SUSANNE PAPER

September 1992

12001 Ambleside Drive
Potomac, Maryland
20854

WHAT STUDENTS THINK OF THE LESSONS

Give us more, they say.

EAGER INTEREST and desire to learn are shown by answers to questions recommended after the ten lessons. Following are from two 6th grade science classes at Lakewood Elementary School, Rockville, Maryland, a suburb of Washington, D.C. December 1992.

One class was taught by Susanne Paper who co-authored the lessons and tested them in 3rd and 4th grades the year before. The other teacher, Betty Brittan, has not seen the lessons and simply followed the explicit directions with equally good results. This indicates that the method can be put to immediate use in any school without special teacher training.

Strong Approval The students, 47 boys and 42 girls, were of mixed ethnic origin and affluence. When asked to rate the lessons, 42 said excellent, 35 good, 12 fair, none poor.

Asked if they wanted more lessons about aviation, 33 of the 47 boys and 21 of the 42 girls said yes.

Asked to suggest improvements, some said the lessons are so good they can not be improved. More experiments and field trips were urged.

Jobs Students were not led to choose aviation careers. They were told jobs would be scarce until growth resumes and the aim of the lessons is to strengthen thinking and help prepare them for all types of work. But 25 of the 47 boys and 9 of the 42 girls said they were interested in aviation work. Preferences included airlines, business flying, military, airport management, and traffic control.

Flight The students' natural interest was sharpened by the lessons and by a visit to Montgomery County Airpark after they had learned enough to know what they were seeing. As a result, 46 of the 47 boys and 32 of the 42 girls said they wanted to learn to fly.

Spreading such enthusiasm can help keep America first in the air. Action is urgent as the number of student pilots declines. Many flight operators and small airports have been closing.

Women The positive attitude of so many of the girls is a big plus. Only about 5% of licenced pilots are women. For more than a half-century, efforts to increase the ration have failed. As the number of working women increases, more will be looking for jobs in aviation. Fear of flying is less a deterrent after learning how flight is made the safest mode of travel.

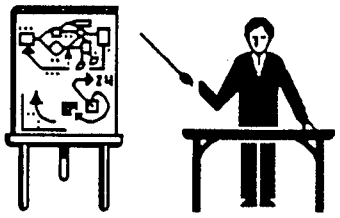
Proof of Learning Best student essays, written after the first ten lessons should be read in class by the writers and shown to prove success of this teaching method. In the words of Connie Chan, age 11, "Wow! There is so much to know about flying. I learned a lot in this unit. Before this, I wanted to fly like a bird. Now, I know that I could fly an airplane myself. I want my own pair of wings someday. Now I know how to get it!" # # # #

U.S. Department
of Transportation

Federal Aviation Administration

ALL PURPOSE AVIATION COUNCILS FOR AMERICAN PROGRESS

THE ILLINOIS PLAN
for Airports and Aviation Education



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Division of Aeronautics and
National Association of State Aviation Officials

Department of Transportation
FEDERAL AVIATION ADMINISTRATION

THE ILLINOIS PLAN

Airports and Aviation Education

We are pleased to provide you with copies of the Illinois Plan, prepared by Mr. Kendall Hoyt, Washington Editor, Airport Services Magazine, for the Division of Aeronautics, Illinois Department of Transportation. Winner of the 1990 National Association of State Aviation Officials (NASAO) for the most innovative state program, the Plan is based on Illinois' extensive experience with airports and airport communities.

The Plan outlines steps for fostering community action groups which would, as part of their activities, encourage and support school authorities in developing and implementing aviation education programs in individual or area wide school settings. Such action groups have an excellent opportunity during the summer as well as the school year to meet with educators at all levels. They can aquaint education leaders with the academic resources provided by the FAA, and can show them the enthusiasm for learning, particularly in math and science, that is generated among students when aviation themes and materials are included in academic subjects. They can also demonstrate how FAA partnerships with professional aviation associations such as NASAO have a synergistic effect in extending resources available to educators and their student populations.

We encourage your distribution of the Plan among local communities. It can be a useful vehicle for local leaders with a can-do attitude as they develop their plans.

We would appreciate being informed of community aviation education action groups currently in existence or forming, in order to network them with other communities and professional organizations. Where action groups exist or are formed, please send the name and address of a point of contact, school(s) involved, and grade levels to FAA Headquarters, AHT-100, Aviation Education Program, 800 Independence Avenue, S.W., Washington, D.C. 20591.

Phillip S. Woodruff
Director of Aviation Education

THE ILLINOIS PLAN

Airports and Aviation Education

WHY ORGANIZE Updated July 1991

TO KEEP AMERICA FIRST in the air, thousands of airports give all areas the benefits of flight and quick acess to the world. Maintaining and improving these assets is a local responsibility. Beyond that, aviation education has a vital role in developing a more technologically capable work force, in the United States.

This requires organized local action, preferably under an All-Purpose Aviation Council to bring all interests together. Action groups for airport support and safety and for aviation education are needed whether or not there is yet a council to unite them.

The function of an Aviation Council is to assign every needed task to a working unit, committee or individual and make the most of local resources. Where airports have problems, organization is most urgent. Aviation Learning Groups are valuable in assisting teachers to prepare for each school year's September opening. These actions can be of great national and local benefit.

HOW TO START

1. Action Group Members - Americans help worthy causes. Many in each area have the ability and interest to work for aviation progress and aviation learning. Action groups should be open to all who want to help, especially the following:

   a. Airport officials and employees
   b. Persons now or formerly employed in aviation
   c. Airport tenants: airlines, flight operators, business aircraft owners, auto rental, etc.
   d. Aviation users including companies and businessmen
   e. Pilots, flying clubs, Civil Air Patrol and Aviation Explorers
   f. Teachers, pre-school through college; parent groups
   g. Government officials and employees
   h. Chambers of Commerce and civic groups
   i. National and local aviation associations
   j. Air Force, Air Nat'l Guard, A.F. Reservists and other military
   k. Retired persons and veterans, especially ex-pilots
   l. Aviation writers, press and radio - TV
   m. Members of airport opposition groups

2. Organizing - An Aviation Council will plan and guide the activities of its members to be organized in working units to cover every task. It will coordinate with cooperating groups.

   a. The first step is to form a small committee, in cooperation with the airport management or aviation education leaders. Outline proposed Council purposes, membership, and structure.

   b. An organizational meeting then should bring together the interests concerned. Elect a chairman and vice-chairman. Name committees including By-laws. Take minutes at all sessions.

   c. By-laws should provide for a president, vice-president, secretary, treasurer, and board of directors representing various aviation interests. For a large Council, an executive committee may act between meetings of the board. Elections and major decisions will be voted by the full membership. Form standing and special committees, each with a chairman and vice-chairman, for all tasks. A Council can incorporate as a non-profit tax-exempt association.

   d. Delegates may be named to represent the Council in state and regional councils and other assemblies.

3. U. S. learning, after decades of decline and billions spent, is not improving. Half our young people leave school unqualified for jobs or college. As we fail to keep pace with the skills of other nations, trade deficits weaken our economy.

   Using aviation as a focus for teaching is a proven way to motivate students to study science, math and other essentials. It reduces school dropouts. It helps prepare youth for work in aviation and aerospace as well as in any modern industry.

   Teaching resources, starting in early childhood, are available to apply in any area. The benefits can spread nationwide without legislation or added cost, either federal, state, or local. Success only requires that aviation leaders help teachers prepare activities and programs for the new generation.

4. An Aviation Education Group is needed in every community.

   a. Members - Pilots; teachers, pre-school through college; parent-teacher representatives; National Guard; Reservists; aviation industry and associations, etc.

   b. Purposes - Arrange and assist school systems and teachers in public and private schools to use aviation to motivate students. Instruct teachers on aviation basics including flight, and the use of available resources. Instruct classes. Arrange airport visits and orientation flights. Provide career guidance information.

   c. Resources - Curricula from pre-school through high school and a variety of teaching aids from federal, state, and private sources are distributed free from approximately 80 FAA Aviation Education Resource Centers across the country. Order from nearest center. Ask for a listing of Aviation Education Resource Centers from:

      Federal Aviation Administration
      Aviation Education Division, AHT-100
      400 - 7th Street, SW
      Washington, DC 20590

   A list of FAA Aviation Education materials is also available from the above address.

Those who have a computer and modem can dail in to FEDIX, a free database which includes an aviation education menu. There is a long distance toll charge for the phone call. FEDIX data line is (301)258-0953; the help line is (301)975-0103.

5. Council activities can include a variety of activities in support of aviation, especially for local airports. Following is a list of examples of such activities:.

   a. Community support - Aid airport master planning, development and bond issues. Aid studies of economic impact to show dollar benefits of the airport, environmental impact, and noise abatement. Attend meetings and hearings to voice airport support and to counter opposition.

   b. Promotion - Publicize airport benefits, plans and events through newspapers, magazines, television and radio. Prepare literature, photos, ads, and exhibits. Send speakers to civic meetings. Provide airport greeters and information desk. Conduct airport tours.

   c. Special events - Airport open house, aviation day, air shows, contests, airplane rides, fly-ins, and any other events that do not interfere with airport operations.

   d. Emergency - Aid plans and drills for crashes, fires, natural disasters, hijackers, and terrorists. Help train firemen and police for aircraft accidents.

   e. Search - Missing aircraft search-and-rescue training, practice, and operations. Encourage and support the Civil Air Patrol.

   f. Beautification - Provide volunteers and funds for airport landscaping, grass cutting, painting, clearing approaches, etc.

   g. Information - Inform members and others by newsletters and bulletins. Include news media and public officials in mailings.

   h. Small airports - Advise those that have no action group.

   i. Heliports - Promote landing sites for helicopters and other VTOL/STOL aircraft.

   k. Volunteers - Enroll those available to help with the above tasks.

6. Airport Safety Committees - To help the airport management prevent accidents, a committee including airport users will be vigilant. The lives they save may be their own.

   a. Members should include representatives of the airport, airlines, flight operators, aircraft owners, pilots, traffic controllers, flight service stations, firemen, and police.

   b. Meetings should be frequent, with minutes taken and programs made interesting.

   c. Specific problems should be addressed and solutions found. Assign tasks. Require reports on ongoing and completed actions. Adapt methods successful elsewhere.

   d. Safety concerns include runway incursions, snow removal, trash and gravel on pavements, obstruction removal, runway and taxiway signs, navaids, birds and animals, air and ground traffic procedures, lighting, marking, friction measuring, NOTAMS, clearing approaches, pavement repair and crack filling. Checklists of points to watch should be followed regularly. Maintain a safety reference file.

The Illinois Plan was supervised by Richard M. Ware, Director of Education and Safety, Illinois Division of Aeronautics. This how-to guide was assembled by Col. Kendall K. Hoyt, AFRes Rtd, Washington Editor, Airport Services Magazine, who started the Civil Air Patrol cadet program in World War II.

Reply Card

Name of school involved: _____
Street address: _____
City _____ State _____ Zip code _____
Point of Contact: _____ Phone Number: _____
Grade level: _____

Send to:

Federal Aviation Administration
Aviation Education Division, AHT-100
400 - 7th Street, SW
Washington, DC 20590

Aviation Education Resource Centers

Alabama

Alabama Aviation
Technical College
Ms. Megan Johnson, Director
Learning Resource Center
PO Box 1209
Ozark, AL 36361
(205) 774-5113

University of North Alabama
Ms. Michele R. Walker
Programming Coordinator
UNA Box 5145
Florence, AL 35632-0001
(205) 760-4623

University Aviation Association
Mr. Gary W. Kiteley, Exec. Dir.
3410 Skyway Drive
Opelika, AL 36801
(205) 844-2434

Alaska

University of Alaska Fairbanks
Mr. Dennis Stephens
Collection Development Officer
Elmer E. Rasmuson Library
Fairbanks, AK 99775-1006
(907) 474-6695

Alaska Pacific University
Dr. Rusty Myers, Project Director
4101 University
Anchorage, AK 99508
(907) 564-8207

University of Alaska Anchorage
Ms. Barbara Sokolov
Library Director
3211 Providence Drive
Anchorage, AK 99508
(907) 786-1825

Arizona

Embry-Riddle Aeronautical Univ.
Ms. Karen Hudson
Educational Programs Coordinator
3200 N. Willow Creek Road
Prescott, AZ 86301
(602) 771-6673

South Mountain High School
Mr. Lew Davis, Program Mngr.
Center for Aerospace Education
5401 S. 7th Street
Phoenix, AZ 85040
(602) 271-3439

Pima Community College
Mr. Tony Gulielmino
Aviation Department Chair
1668 South Research Loop Road
Tucson, AZ 85730
(602) 884-6186

Arkansas

Crowley's Ridge Education Service
Coop.
Mr. Louis Midkiff
P.O. Box 377
Harrisburg, AR 72432
(501) 578-5426

California

Apple Valley Science & Tech. Cntr.
Mr. Rick Piercy, Coordinator
P.O. Box 2968, 15552 Wichita
Apple Valley, CA 92307
(619) 242-3514

National University
Mr. Ernest Wendt, Chairman
Department of Applied Sciences
4141 Camino Del Rio South
San Diego, CA 92108
(619) 563-7122

San Jose State University
Dr. H. Gene Little, Chairman
Department of Aviation
1 Washington Square
San Jose, CA 95192-0081
(408) 924-6580

Museum of Flying
Mr. Harvey Ferer
2772 Donald Douglas Loop N.
Santa Monica, CA 90405
(310) 392-8822

San Bernardino Co. Super. of Sch
Ms. Nancy Harlan, Coordinator
Instructional Services Division
601 North E. Street
San Bernardino, CA 92410-3093
(714) 387-3152

Riverside County Office of Ed.
Ms. Mary Ann Liette, Cord. of ERC
3939 - 13th Street
Riverside, CA 92502-0868
(909) 788-6684

Colorado

U.S. Space Foundation
Dr. Jerry Brown
Educational Director
1525 Vapor Trail
Colorado Springs, CO 80916
(719) 550-1000

Metropolitan State
College of Denver
Mr. Jonathan R. Burke
Assistant Professor
Aerospace Science Department
Campus Box 30
P.O. Box 173362
Denver, CO 80217-3362
(303) 556-2923

Connecticut

Connecticut DOT
Bureau of Aviation and Ports
Ms. Andre J. Libert
Dir. of Marketing for Aviation
24 Wolcott Hill Road
PO Drawer A
Wethersfield, CT 06129
(203) 566-4417

Delaware

Delaware Teachers Center
Ms. Stephanie Wright
Claymont Education Campus
3401 Green Street
Claymont, DE 19703
(302) 798-3806

Florida

Embry-Riddle Aeronautical Univ.
Ms. Patricia Fleener-Ryan
AvEd Teacher Resource Center
Daytona Beach, FL 32114
(904) 226-6499

Florida Institute of Technology
Dr. Ballard M. Barker, Head
Department of Aviation Studies
The School of Aeronautics
150 West University Boulevard
Melbourne, FL 32901-6988
(407) 768-8000 ext. 8120

Florida Memorial College
Mr. Anthony J. Sharp, Director
Division of Airway Science
15800 Northwest 42 Avenue
Miami, FL 33054
(305) 623-1440

Georgia

Conyers Middle School
Ms. Viki Dennard
Assistant Principal
335 Sigman Road
Conyers, GA 30207-3699
(404) 483-3371

Museum of Aviation at Robins AFB
Ms. Joyce Carlton
Director of Education
P.O. Box 2469
Warner Robins, GA 31099
(912) 926-4242

Hawaii

Mid-Pacific Institute
Dr. Phillip R. Brieske
Aviation/Space Science
2445 Kaala Street
Honolulu, HI 96822
(808) 973-5000

State of Hawaii
Department of Transportation
Mr. Rodney M. Kuba
Airports Division
Honolulu International Airport
Gate 29, EWA Service Court Road
Honolulu, HI 96819-1898
(808) 836-6542

Idaho

Idaho State Bureau of Aeronautics
Mr. John Maakestad
Safety/Information Officer
Chief Pilot
3483 Rickenbacker Street
Boise, ID 83705-5018
(208) 334-8775

Illinois

Parks College of St. Louis Univ.
Dr. Peggy Baty
Associate Vice Pres. and Dean
500 Falling Springs Road
Cahokia, IL 62206
(618) 337-7500

Southern Illinois University
Dr. Elaine Vitello
College of Technical Careers
Room 222
Carbondale, IL 62901
(618) 453-8821

State of Illinois
Division of Aeronautics
Mr. Richard M. Ware
One Langhorne Bond Drive
Capital Airport
Springfield, IL 62707-8415
(217) 785-8516

Iowa

The University of Northern Iowa
Dr. Thomas Switzer, Dean
205 Schindler Education Center
Cedar Falls, IA 50614-0610
(319) 273-2717

Kansas

Hutchinson Community College
Mr. Edward E. Berger, President
1300 N. Plum
Hutchinson, KS 67501
(316) 665-3505

Kansas State University-Salina
Ms.Karlene Propst
Tullis Library
2408 Scanlan Avenue
Salina, KS 67401
(913) 825-0275

Louisiana

Louisiana State University
Dr. Marlon Abbas, Director
Transportation Systems Group
Louisiana Trans. Research Center
4101 Gourrier Avenue
Baton Rouge, LA 70808
(504)767-9127

Northeast Louisiana University
Mr.Ernie Bruce
Room 103, Chemistry & Natural
Sciences Building
Monroe, LA 71209-0590
(318) 342-1784

Maine

Kennebec Valley Tech. College
Ms. Sue Doner
92 Western Avenue
Fairfield, ME 04937-0020
(207) 453-9762

Biddeford School Department
Ms. Sara Jane Poli
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Biddeford, ME 04005
(207) 282-8280

Penobscot Nation Tribal Admin.
Mr. Mark Sanborn, Asst. Director
Vocational Training & Education
6 River Road, Community Bldg.
Indian Island, ME 04468
(207) 827-7776

Northern Maine Technical Center
Mr. Timothy D. Crowley
Dean of Students
33 Edgemont Drive
Presque Isle, ME 04769
(207) 769-2461

Massachusetts

Bridgewater State College
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Management Science & Aviation
Science Department
Bridgewater, MA 02325
(508) 697-1395

North Shore Community College
Dr. Robert Finklestein
One Ferncroft Road
Danvers, MA 01923
(508) 762-4000 ext. 6296

Museum of Science
Ms. Carolyn Kirdahy
Lyman Library
Science Park
Boston, MA 02114-1099
(617) 589-0266

Lexington Public School System
Dr. Nicholas Tzimopoulos, Director
Curriculum/Science Education
1557 Massachusetts Avenue
Lexington, MA 02173
(617) 861-2484

Westfield State College
Ms. Maureen McCartney
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Ely Campus Center
Western Avenue
Westfield, MA 01086
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(313) 370-2485

Project STARS
Ms. Barbara Koscak
Box 450082, Building 814
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(313) 466-4884

Minnesota

Minnesota DOT
Office of Aeronautics
Mr. Gordon Hoff, Director
Aviation Education Relations
222 East Plato Boulevard
St. Paul, MN 55107-1618
(612) 297-7652

Vermilion Community College
Mr. Julius Salinas
Aviation Director
1900 E. Camp Street
Ely, MN 55731
(218) 365-7200

Mississippi

Jackson State University
Dr. Harry A. Cooley, Director
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Montana

Montana DOT Aeronautics Div.
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Nebraska

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New Hampshire

New Hampshire DOT
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Mr. Ronald Wanner
65 Airport Road
Concord Municipal Airport
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(603) 271-2551

Daniel Webster College
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20 University Drive
Nashua, NH 03063-1699
(603) 883-3556

New Mexico

University of New Mexico
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FAA/NASA Teacher Resource Center
Division of Continuing Education
Albuquerque, NM 87131-4006
(505) 277-2631

New Mexcio State University
Ms. Judy McShannon
Room 103, Goddard Hall
Las Cruces, NM 88003-0001
(505) 646-6414

New Jersey

Northeast Curriculum Coord. Center
Dr. Martha Pocsi
Division of Vocational Education
Crest Way
Aberdeen, NJ 07747
(908) 290-1900

New York

Dowling College
Dr. Albert E. Donor
Provost, Executive Vice President
Oakdale Long Island, NY 11769
(516) 244-3200

North Dakota

University of North Dakota
Mr. Charles L. Robertson
Assistant Professor
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Box 8216, University Station
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Technology Annex
Bowling Green, OH 43403-0307
(419) 372-8926

Oklahoma

University of Oklahoma
Dr. Lee Morris, Director
Education & Aviation/Aerospace
1700 Asp Avenue
Norman, OK 73037-0001
(405) 325-1964

Rhode Island

Warwick Public Schools
Mr. Anthony Gagliardi
Warwick Career & Tech School
575 Centerville Road
Warwick, RI 02886
(401) 737-3300

South Dakota

Sisseton Wahpeton Comm. College
Mr. Chip Harris, Director
Office of Planning and Development
Old Agency Box 689
Sisseton, SD 57262-0689
(605) 698-3966

Tennessee

Middle Tennessee State University
Dr. Wallace R. Maples, Chairman
Aerospace Department
East Main Street
P.O. Box 67 MTSU
Murfreesboro, TN 37132
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Texas

Texas Southern University
Mr. Isaac Nettey, Director
Airway Science Program
3100 Cleburne Avenue
Houston, TX 77004
(713) 639-1847

University of Texas at El Paso
Dr. Jim Milson, Chairman
Room 403, Education Building
El Paso, TX 79968-0574
(915) 747-5426

Texas State Technical College
Campus Librarian
Aerospace Technologies
3801 Campus Drive
Waco, TX 78708
(817) 799-3611

Palo Alto College
Mr. Bruce Hoover
Aviation Department
1400 West Villarette
San Antonio, TX 78224
(512) 921-5162

Frontiers of Flight Museum
Mr. Olin Lancaster, Director
Love Field Terminal, BL-38
Dallas, TX 75235
(214) 350-3600

Utah

Utah Valley Community College
Dr. P.R. "Ron" Smart
Director, Aviation Science Dept.
800 West 1200 South
Orem, Utah 84058
(801) 222-8000

Vermont

St. Johnsbury Academy
Mr. John Barney
Vocational Director
St. Johnsbury, VT 05816
(802) 748-8171

Virginia

Virginia Aviation Museum
Ms. Betty P. Wilson
5701 Huntsman Road
Sandston, VA 23150-1946
(804) 786-1364

Washington

Museum of Flight
Mr. Gregory Moyce
Education Program Manager
9404 East Marginal Way South
Seattle, WA 98108
(206) 764-5700

West Virginia

Salem-Teikyo University
Dr. Ronald Ohl
President
223 West Main Street
Salem, WV 26426
(304) 782-5234

Wisconsin

Experimental Aircraft Association
Mr. Chuck Larsen
EAA Aviation Center
3000 Poberezny Road
Oshkosh, WI 54903-3065
(414) 426-4800

Department of Transportation
Bureau of Aeronautics
Mr. Duane Esse
4802 Sheboygan Avenue
P.O. Box 7914
Madison, WI 53707-7914
(608) 266-3351

University of Wisconsin-Superior
Mr. Michael J. Wallschlaeger
Chairman
Division of Education
1800 Grand Avenue
Superior, WI 54880-2898
(715) 394-8309

List of FAA Aviation Education Materials

Elementary Level

_____	GA-20-30	Aviation Science Activities for Elementary Grades
_____	GA-20-30B	Demonstration Aids for Aviation Education
_____		NAAA/Curriculum Guide for Elementary
_____	GA-20-30S	Nuestro Primer Veulo
_____	GA-300-120	A Trip to the Airport
_____	GA-300-143A	August Martin Activities Book
_____	APA-158-91	The Main Parts of an Airplane
_____	APA-5-146-83	Safety in the Air: Unit Guide
_____	APA-6-153-91	Teacher Guide to Aviation Education for Grades 2-6
_____	APA-6-155-88	How We Made the First Flight
_____	APA-100-90	Aviation & Space Curriculum Guide K-3
_____		Air Bear Goes to School
_____		Air Bear at Community Events
_____		Project Air Bear

Middle & Secondary Level

_____	APA-5-145-83	Aviation Curr. Guide for Middle/Secondary Level
_____		NAAA/Curriculum Guide for Secondary Level
_____	GA-300-143B	A Model Aerospace Curriculum:August Martin H.S.
_____	GA-300-144	Women in Aviation & Space

Aviation Career Series

_____	PA-120-91	Your Career in Aviation: "The Sky's the Limit"
_____	PA-121-91	Pilots & Flight Engineers
_____	PA-122-91	Flight Attendants
_____	PA-123-91	Airline Non-Flying Careers
_____	PA-124-91	Aircraft Manufacturing
_____	PA-125-91	Aviation Maintenance & Avionics
_____	PA-126-91	Airport Careers
_____	PA-127-91	Government Careers
_____	FAA-ASI-006	Aviation Safety Inspector
_____	FAA-ATC-008	Air Traffic Control Specialist

For All Education Levels

_____	PA-128-91	Women in Aviation
_____	PA-129-92	Aviation Education Resource Centers
_____	APA-5-149-92	Teacher's Guide to Aviation Education Resources
_____	APA-6-152-92	List of Aviation Education Materials
_____	APA-6-156-92	Aviation Education Programs & Materials Brochure
_____		This is the FAA
_____	FAA-APA-PG-13	Guide to FAA Publications
_____	FAA-FVC-5M-92	FAA Film Catalog/Video Catalog
_____		Post-SecondaryAviation & Space Education Reference Guide

For single copies, write to: Government Printing Office
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